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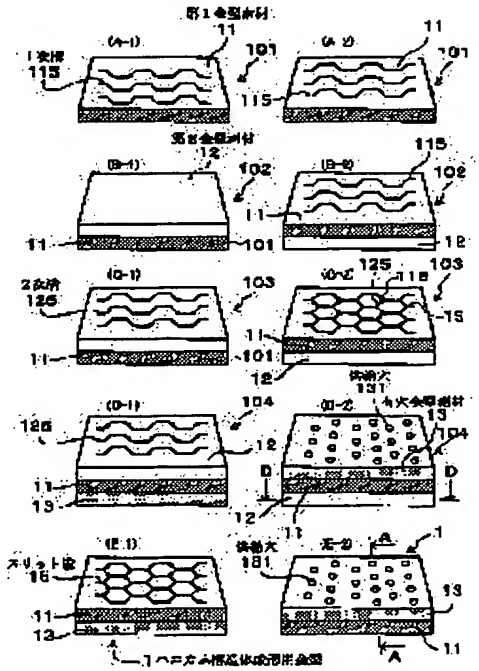
(54) DIE FOR MOLDING HONEYCOMB STRUCTURAL BODY AND MANUFACTURE THEREOF

(57)Abstract:
PROBLEM TO BE SOLVED: To manufacture a die for honeycomb structural body molding die, with which a honeycomb structural body can be molded without development of troubles such as strains or the like, by a wire electrical discharge machining.
SOLUTION: This die is for molding a honeycomb structural body having feeding holes 131, through which a material is fed, and slit grooves 15, which communicate with the feeding holes 131 so as to mold the material into a honeycomb shape. On a first die material 11, a large number of independent stripes of through primary-grooves 115 are formed by a wire electrical discharge machining. After a second die material 12 is bonded to the top surface of the first die material 11, similarly, secondary grooves 125 are formed. As a result, in the first die material 11, the secondary grooves 125 form a honeycomb-like slit groove 15 together with the primary grooves 115. After a holed die material 13 is bonded on the under surface of the first die material 11, the second die material 12 is removed.



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* NOTICES *

CLAIMS

[Claim(s)]
[Claim 1] In the approach of manufacturing the honeycomb structure object molding die which has a slit slot for it bein open for free passage in the supply hole and this supply hole for supplying an ingredient, and fabricating an ingredient in a honeycomb configuration this manufacture approach The penetrated primary slot of several articles is formed by th wire electron discharge method. mutually-independent for the 1st metal mold material -- the bottom -- many -- The 1st process which acquires primary processing objects, and the 2nd process which joins the 2nd metal mold material to the top face of the primary above-mentioned processing objects, and acquires a secondary elaboration object, mutually-independent on the above-mentioned secondary elaboration object -- the bottom -- many -- the penetrated secondary slo of several articles by the wire electron discharge method By forming the honeycomb slit slot on the above which forms and is formed when the above-mentioned secondary slot is open for free passage with the above-mentioned primary slo for the above-mentioned 1st metal mold material in this case The manufacture approach of the honeycomb structure object molding die characterized by consisting of the 3rd process which acquires a 3rd processing object, the 4th proces which joins the owner hole metal mold material which has the above-mentioned supply hole to the inferior surface of tongue of the above-mentioned 1st metal mold material, and acquires a 4th processing object, and the 5th process whic removes the above-mentioned 2nd metal mold material from the above-mentioned 4th processing object.
[Claim 2] In the approach of manufacturing the honeycomb structure object molding die which has a slit slot for it bein open for free passage in the supply hole and this supply hole for supplying an ingredient, and fabricating an ingredient in a honeycomb configuration this manufacture approach The penetrated primary slot of several articles is formed by th wire electron discharge method. it connected with the 1st metal mold material in picture drawn without lifting the brus from the paper -- many -- The 1st process which acquires primary processing objects, and the 2nd process which joins the 2nd metal mold material to the top face of the primary above-mentioned processing objects, and acquires a secondary elaboration object, it connected with the above-mentioned secondary elaboration object in picture drawn without lifting the brush from the paper -- many -- the penetrated secondary slot of several articles by the wire electron discharge method By forming the honeycomb slit slot on the above which forms, and is formed when the above-mentioned secondary slot is open for free passage with the above-mentioned primary slot for the above-mentioned 1st metal mold material in this case The manufacture approach of the honeycomb structure object molding die characterize by consisting of the 3rd process which acquires a 3rd processing object, the 4th process which joins the owner hole metal mold material which has the above-mentioned supply hole to the inferior surface of tongue of the above-mentioned 1st metal mold material, and acquires a 4th processing object, and the 5th process which removes the above-mentioned 2nd metal mold material from the above-mentioned 4th processing object.
[Claim 3] It is the manufacture approach of the honeycomb structure object molding die characterized by the 5th process of the above removing the 2nd metal mold material with surface grinding in claim 1 or 2.
[Claim 4] It is the manufacture approach of the honeycomb structure object molding die characterized by the 5th process of the above removing the 2nd metal mold material by wire cut in claim 1 or 2.
[Claim 5] It is the manufacture approach of the honeycomb structure object molding die characterized by the above-mentioned slit slot being a square, a hexagon, or circular either in any 1 term of claims 1-4.
[Claim 6] It is the manufacture approach of the honeycomb structure object molding die characterized by performing junction for the above-mentioned 1st metal mold material and the above-mentioned 2nd metal mold material, and junction for the above-mentioned 1st metal mold material and the above-mentioned owner hole metal mold material by making a junction medium placed between planes of composition in any 1 term of claims 1-5.
[Claim 7] It is the manufacture approach of the honeycomb structure object molding die characterized by to join the above-mentioned junction medium to both sides of the above-mentioned 1st metal mold material beforehand, and to form the above-mentioned primary slot in the above-mentioned 1st metal mold material and the above-mentioned

junction medium in claim 6 at coincidence, and to form the above-mentioned secondary slot in coincidence at the above-mentioned 1st metal mold material, the above-mentioned 2nd metal-mold material, and the above-mentioned junction medium.

[Claim 8] It is the manufacture approach of the honeycomb structure object molding die which joins beforehand the above-mentioned junction medium which joins the above-mentioned 1st metal-mold material and the above-mentioned owner hole metal-mold material in claim 6 to the top face of the non-hole metal-mold material which is in the condition before the supply hole formation in the above-mentioned owner hole metal-mold material, and is characterized by to form the above-mentioned supply hole in coincidence at the above-mentioned non-hole metal-mold material and the above-mentioned junction medium.

[Claim 9] The above-mentioned junction medium which joins the above-mentioned 1st metal mold material and the above-mentioned owner hole metal mold material in claim 6 is the manufacture approach of the honeycomb structure object molding die characterized by forming a free passage hole in the supply hole formed in the above-mentioned owner hole metal mold material, and a location open for free passage beforehand with at least 1 means of drilling, an electron discharge method, and press working of sheet metal.

[Claim 10] It is the manufacture approach of the honeycomb structure object molding die which it joins to a metal mold material by thermal diffusion or soldering, and the above-mentioned junction medium forms a metallic foil in any 1 term of claims 6-9, comes to form in the above-mentioned metal mold material by plating or vacuum evaporationo, and is characterized by the thickness of the above-mentioned junction medium being 0.005-1mm.

[Claim 11] It is the manufacture approach of the honeycomb structure object molding die characterized by the above-mentioned 1st metal mold material, the 2nd metal mold material, and an owner hole metal mold material consisting of cemented carbide in any 1 term of claims 1-10.

[Claim 12] It is the manufacture approach of the honeycomb structure object molding die characterized by the thing of iron, cobalt, and nickel which the metal more than a kind is added 3 to 30% at least, and is considered as a sintered allo to the carbide powder of the metal with which the above-mentioned cemented carbide belongs to periodic table the 4a, 5a, and 6a group in claim 11 which consists of carbide of the metal more than a kind at least.

[Claim 13] The honeycomb structure object molding die characterized by the above-mentioned slit slot and the above-mentioned supply hole coming to be open for free passage while the 1st metal mold material in which the slit slot whic the shape of a honeycomb penetrated was formed, and the owner hole metal mold material which has a supply hole for supplying an ingredient come to join.

[Claim 14] It is the honeycomb structure object molding die characterized by the above-mentioned 1st metal mold material, the 2nd metal mold material, and an owner hole metal mold material consisting of cemented carbide in claim 13.

[Claim 15] It is the honeycomb structure object molding die characterized by the thing of iron, cobalt, and nickel which the metal more than a kind is added 3 to 30% at least, and is considered as a sintered alloy to the carbide powder of the metal with which the above-mentioned cemented carbide belongs to periodic table the 4a, 5a, and 6a group in claim 14 which consists of carbide of the metal more than a kind at least.

[Claim 16] The honeycomb structure object molding die characterized by making a junction medium have intervened between the above-mentioned 1st metal mold material and the above-mentioned 2nd metal mold material and between the above-mentioned 1st metal mold material and the above-mentioned owner hole metal mold material in any 1 term o claims 13-15.

[Claim 17] It is the honeycomb structure object molding die which it joins to a metal mold material by thermal diffusio or soldering, and the above-mentioned junction medium forms a metallic foil in claim 16, comes to form in the above-mentioned metal mold material by plating or vacuum evaporationo, and is characterized by the thickness of the above-mentioned junction medium being 0.005-1mm.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the honeycomb structure object molding die which manufactures the metal mold for fabricating a honeycomb structure Plastic solid using a wire electron discharge method, and its manufacture approach.
[0002]
[Description of the Prior Art] For example, the honeycomb structure object made from a ceramic which used cordierite etc. as the principal component is manufactured by carrying out extrusion molding of the ingredient using a molding die. This honeycomb structure object forms a septum in the shape of a grid, comes to constitute many cels, and has various configurations, such as a square and a hexagon, as that cel configuration.
[0003] For example, in order to manufacture the honeycomb structure object which has a hexagon-like cel, the metal mold which has a hexagon grid-like slit slot is used. The honeycomb structure object molding die which specifically ha: the slit slot 15 which opened for free passage in the supply hole 131 and this supply hole 131 for ingredient supply as shown in drawing 2 , and was prepared in the shape of a hexagon-head grid is used.
[0004] As an approach of manufacturing the honeycomb structure object molding die like the above, there is the manufacture approach using the wire electron discharge method indicated by JP,2-52703,A conventionally. The manufacture approach of the above-mentioned conventional honeycomb structure object molding die 9 is explained using drawing 16 and drawing 17 . In addition, in drawing 16 , - (A-1) (D-1) is the perspective view which turned the top face of a primary processing object - 3rd processing object and the honeycomb structure object molding die 9 up, and - (A-2) (D-2) is the perspective view which turned the inferior surface of tongue up.
[0005] first, mutually-independent for the 1st metal mold material 91 -- the bottom -- many -- the penetrated primary slot 915 of several articles is formed by the wire electron discharge method, and primary processing objects 901 are acquired (drawing 16 (A-1), (A-2)). Subsequently, the 2nd metal mold material 92 is joined to the top face of the primary above-mentioned processing objects 901, and the secondary elaboration object 902 is acquired (drawing 16 (B 1), (B-2)).
[0006] subsequently, mutually-independent on the above-mentioned secondary elaboration object 902 -- the bottom -- many -- the 3rd processing object 903 is acquired by forming the penetrated secondary slot 925 of several articles by th wire electron discharge method (drawing 16 (C-1)). Under the present circumstances, when the above-mentioned secondary slot 925 is open for free passage with the primary slot 915 for the above-mentioned 1st metal mold material 91, the honeycomb slit slot 95 on the above is formed (drawing 16 (C-2)).
[0007] Subsequently, the above-mentioned honeycomb structure object molding die 9 is obtained by joining the owner hole metal mold material 93 which has the above-mentioned supply hole 931 to the inferior surface of tongue of the above-mentioned 2nd metal mold material 92 (drawing 16 (D-1), (D-2)). At this time, as shown in drawing 17 (B), the above-mentioned supply hole 931 is joined so that it may be arranged in the location of the intersection of the above-mentioned slit slot 95.
[0008] Thus, the honeycomb structure object molding die 9 is manufactured using a wire electron discharge method. Since a wire electron discharge method is used in the above-mentioned manufacture approach, a honeycomb structure object molding die can be manufactured with easily and sufficient productive efficiency for the slit slot of the honeycomb configuration of arbitration.
[0009]
[Problem(s) to be Solved] However, there are the following troubles in the manufacture approach of the above-mentioned conventional honeycomb structure object molding die 9. That is, since the above-mentioned honeycomb

structure object molding die 9 makes the 2nd metal mold material 92 intervene between the 1st metal mold material 91 and the owner hole metal mold material 93 and is considering as 3 layer structures, the slit slot 95 formed in the above-mentioned 1st metal mold material 91 is not connected with the direct above-mentioned supply hole 931 (drawing 17 (A)).

[0010] That is, as shown in drawing 17 (D), the slit slot 95 of the shape of a honeycomb of a hexagon is established in the above-mentioned 1st metal mold material 91. That is, one unit of the above-mentioned hexagon is formed of the slit slot of six sides shown in the signs M, N, O, P, Q, and R in drawing 18 (A).

[0011] On the other hand, as shown in the above-mentioned 2nd metal mold material 92 at drawing 17 (C) and drawing 16 (C-1), the above-mentioned secondary slot 925 is [only being formed in the zigzag configuration, and]. That is, as shown in drawing 18 (B), it is [that the secondary slots S, T, U, and V of four sides are only formed, and] about the part corresponding to the hexagon according in the above-mentioned 2nd metal mold material 92 to the above-mentioned slit slots M, N, O, P, Q, and R.

[0012] Therefore, although the ingredient supplied to the above-mentioned supply hole 931 is supplied to the above-mentioned secondary slots S, T, U, and V and this is supplied to the direct above-mentioned slit slots M, N, O, and Q, the above-mentioned slit slots P and R are not supplied directly. Consequently, an ingredient is not fully supplied to the above-mentioned slit slots P and R, but a possibility that faults, such as distortion, may arise is in the honeycomb structure object extruded from the above-mentioned honeycomb structure object molding die 9.

[0013] Moreover, it becomes difficult [the ingredient supplied to the above-mentioned secondary slot 925], in order [which it is here] to carry out extent shaping and to spoil a fluidity to supply homogeneity throughout the above-mentioned slit slot 95. Therefore, a possibility that faults, such as distortion, may arise is in the honeycomb structure object acquired.

[0014] This invention was not made in view of this conventional trouble, and tends to offer the honeycomb structure object molding die which can manufacture the honeycomb structure object molding die which can fabricate the honeycomb structure object which faults, such as distortion, do not generate using a wire electron discharge method, and its manufacture approach.

[0015]

[Means for Solving the Problem] In the approach of manufacturing the honeycomb structure object molding die which has a slit slot for invention according to claim 1 being open for free passage in the supply hole and this supply hole for supplying an ingredient, and fabricating an ingredient in a honeycomb configuration The penetrated primary slot of several articles is formed by the wire electron discharge method. this manufacture approach is mutually-independent fo the 1st metal mold material -- the bottom -- many -- The 1st process which acquires primary processing objects, and the 2nd process which joins the 2nd metal mold material to the top face of the primary above-mentioned processing objects and acquires a secondary elaboration object, mutually-independent on the above-mentioned secondary elaboration object -- the bottom -- many -- the penetrated secondary slot of several articles by the wire electron discharge method By forming the honeycomb slit slot on the above which forms, and is formed when the above-mentioned secondary slo is open for free passage with the above-mentioned primary slot for the above-mentioned 1st metal mold material in this case It is in the manufacture approach of the honeycomb structure object molding die characterized by to consist of the 3rd process which acquires a 3rd processing object, the 4th process which joins the owner hole metal-mold material which has the above-mentioned supply hole to the inferior surface of tongue of the above-mentioned 1st metal-mold material, and acquires a 4th processing object, and the 5th process which removes the above-mentioned 2nd metal-mol material from the above-mentioned 4th processing object.

[0016] What should be most observed in this invention joins an owner hole metal mold material to the inferior surface of tongue of the above-mentioned 1st metal mold material in the 4th process of the above, and is removing the 2nd metal mold material from the above-mentioned 4th processing object in the 5th process of the above. That is, the direct above-mentioned owner hole metal mold material is joined to the inferior surface of tongue of the above-mentioned 1st metal mold material in which the honeycomb slit slot on the above was formed (drawing 1 (D-1), reference (D-2)). Then, the 2nd metal mold material joined to the top face of the above-mentioned 1st metal mold material is removed (drawing 1 (E-1), reference (E-2)).

[0017] Next, it explains per operation effectiveness of this invention. In the manufacture approach of the above-mentioned honeycomb structure object molding die, after joining the direct above-mentioned owner hole metal mold material to the inferior surface of tongue of the above-mentioned 1st metal mold material in which the honeycomb slit slot on the above was formed like the above, the 2nd metal mold material joined to the top face of the above-mentioned 1st metal mold material is removed.

[0018] Therefore, the above-mentioned slit slot of the honeycomb structure object molding die obtained by the above-

mentioned manufacture approach is connected with the direct above-mentioned supply hole. So, the ingredient supplied to the above-mentioned supply hole is directly supplied to the above-mentioned slit slot in shaping of a honeycomb structure object. That is, the ingredient supplied to the above-mentioned supply hole is supplied to the direct above-mentioned slit slot in the condition [that there has been a fluidity]. So, an ingredient does not have a possibility that fault, like homogeneity is supplied throughout the above-mentioned slit slot, and the honeycomb structure object fabricated is distorted may arise.

[0019] According to this invention, like the above, the manufacture approach of the honeycomb structure object molding die which can manufacture the honeycomb structure object molding die which can fabricate the honeycomb structure object which faults, such as distortion, do not generate using a wire electron discharge method can be offered.

[0020] Next, it sets to the approach of manufacturing the honeycomb structure object molding die which has a slit slot for it being open for free passage in the supply hole and this supply hole for supplying an ingredient, and fabricating an ingredient in a honeycomb configuration like invention according to claim 2. The penetrated primary slot of several articles is formed by the wire electron discharge method. this manufacture approach was connected with the 1st metal mold material in picture drawn without lifting the brush from the paper -- many -- The 1st process which acquires primary processing objects, and the 2nd process which joins the 2nd metal mold material to the top face of the primary above-mentioned processing objects, and acquires a secondary elaboration object, it connected with the above-mentioned secondary elaboration object in picture drawn without lifting the brush from the paper -- many -- the penetrated secondary slot of several articles by the wire electron discharge method By forming the honeycomb slit slot on the above which forms, and is formed when the above-mentioned secondary slot is open for free passage with the above-mentioned primary slot for the above-mentioned 1st metal mold material in this case There is the manufacture approach of the honeycomb structure object molding die characterized by to consist of the 3rd process which acquires a 3rd processing object, the 4th process which joins the owner hole metal-mold material which has the above-mentioned supply hole to the inferior surface of tongue of the above-mentioned 1st metal-mold material, and acquires a 4th processing object, and the 5th process which removes the above-mentioned 2nd metal-mold material from the above-mentioned 4th processing object.

[0021] namely, the 1st process of the above and the 3rd process -- setting -- invention of claim 1 -- differing -- the abov -- many -- without carrying out mutually-independent [of the primary slot of several articles, and the secondary slot], i is made to connect in picture drawn without lifting the brush from the paper, and forms (drawing 5 (A-1), reference (C-1)). Therefore, it is not necessary to prepare many through holes of the minor diameter used as the starting point at the time of carrying out a wire electron discharge method. Moreover, whenever it processes a primary slot or a secondary slot one articles, it is not necessary to **********. Therefore, a honeycomb structure object molding die can be manufactured with much more sufficient productive efficiency.

[0022] Next, the 5th process of the above can also remove the 2nd metal mold material with surface grinding like invention according to claim 3. Thereby, the above-mentioned 2nd metal mold material is easily removable. Moreover, there is an advantage that especially floor to floor time is short, and a workmanship side becomes smooth in this case.

[0023] Next, the 5th process of the above can also remove the 2nd metal mold material by wire cut like invention according to claim 4. Also in this case, the above-mentioned 2nd metal mold material is easily removable. Moreover, there is an advantage that especially weld flash does not occur, in this case.

[0024] Next, the above-mentioned slit slot can also be made into a square, a hexagon, or circular either like invention according to claim 5. That is, one grid of the honeycomb formed of the above-mentioned slit slot can consider as a square, a hexagon, and a round shape.

[0025] Thereby, it has the slit slot of arbitration, such as a square, and the honeycomb structure object molding die for fabricating the honeycomb structure object of each configuration can be obtained. in order that [in addition,] the manufacture approach of the above-mentioned honeycomb structure object molding die may form the above-mentioned slit slot by the wire electron discharge method -- the above -- it is easily processible even if it is the slit slot of which configuration.

[0026] Next, as for junction for the above-mentioned 1st metal mold material and the above-mentioned 2nd metal mold material, and junction for the above-mentioned 1st metal mold material and the above-mentioned owner hole metal mold material, it is desirable like invention according to claim 6 to carry out by making a junction medium placed between planes of composition. Thereby, junction for the above-mentioned 1st metal mold material and the above-mentioned 2nd metal mold material and junction for the above-mentioned 1st metal mold material and the above-mentioned owner hole metal mold material can be ensured [easily and].

[0027] Next, like invention according to claim 7, the above-mentioned junction medium is beforehand joined to both sides of the above-mentioned 1st metal mold material, and the above-mentioned primary slot is formed in the above-

mentioned 1st metal mold material and the above-mentioned junction medium at coincidence, and, as for the above-mentioned secondary slot, it is desirable to form in the above-mentioned 1st metal mold material, the above-mentioned 2nd metal mold material, and the above-mentioned junction medium at coincidence. In this case, the above-mentioned junction medium does not remain between the slit slot formed in the above-mentioned 1st metal mold material, and the supply hole of the above-mentioned owner hole metal mold material. Therefore, it is not necessary to remove this junction medium alternatively after junction for the above-mentioned 1st metal mold material and an owner hole metal mold material. so -- much more -- easy -- honeycomb structure object molding -- public funds -- a mold can be manufactured.

[0028] In addition, it joins only to the inferior surface of tongue of the above-mentioned 1st metal mold material beforehand, and the above-mentioned junction medium can also form the above-mentioned secondary slot in the above-mentioned 1st metal mold material, the above-mentioned 2nd metal mold material, and the above-mentioned junction medium at coincidence. also in this case, the above -- the same -- easy -- honeycomb structure object molding -- public funds -- a mold can be manufactured.

[0029] Next, the above-mentioned junction medium which joins the above-mentioned 1st metal mold material and the above-mentioned owner hole metal mold material is beforehand joined to the top face of the non-hole metal mold material which is in the condition before the supply hole formation in the above-mentioned owner hole metal mold material like invention according to claim 8, and, as for the above-mentioned supply hole, it is desirable to form in the above-mentioned non-hole metal mold material and the above-mentioned junction medium at coincidence. Also in this case, the above-mentioned junction medium does not remain between the slit slot formed in the above-mentioned 1st metal mold material, and the supply hole of the above-mentioned owner hole metal mold material. Therefore, it is not necessary to remove this junction medium alternatively after junction for the above-mentioned 1st metal mold material and an owner hole metal mold material. so -- much more -- easy -- honeycomb structure object molding -- public funds - a mold can be manufactured.

[0030] Next, as for the above-mentioned junction medium which joins the above-mentioned 1st metal mold material an the above-mentioned owner hole metal mold material, it is desirable like invention according to claim 9 to form a free passage hole in the supply hole formed in the above-mentioned owner hole metal mold material and a location open for free passage beforehand with at least 1 means of drilling, an electron discharge method, and press working of sheet metal. Thereby, there is no possibility that the cutting waste may remain for an owner hole metal mold material, at the time of formation of the free passage hole of the above-mentioned junction medium.

[0031] Next, like invention according to claim 10, join to a metal mold material by thermal diffusion or soldering, and the above-mentioned junction medium forms a metallic foil, it comes to form in the above-mentioned metal mold material by plating or vacuum evaporationo, and, as for the thickness of the above-mentioned junction medium, it is desirable that it is 0.005-1mm. Here, the above-mentioned metal mold material means the above-mentioned 1st metal mold material, the 2nd metal mold material, an owner hole metal mold material, or a non-hole metal mold material. Namely, the above-mentioned junction medium arranges a metallic foil on a top face or inferior surfaces of tongue, suc as the above-mentioned 1st metal mold material and an owner hole metal mold material, and forms it by joining by thermal diffusion or soldering. Or the above-mentioned junction medium is formed by forming a metal by vacuum evaporationo of plating, PVD, CVD, etc., etc. on a top face or inferior surfaces of tongue, such as the above-mentioned 1st metal mold material and an owner hole metal mold material.

[0032] Thereby, junction for the above-mentioned 1st metal mold material and the above-mentioned 2nd metal mold material or junction for the above-mentioned 1st metal mold material and the above-mentioned owner hole metal mold material can be ensured [still more easily and]. As for the above-mentioned metallic foil, it is desirable that it is the metal or alloy which uses gold, silver, copper, nickel, etc. as a principal component from a viewpoint of the junction nature which influences diffusibility with the metal powder contained in the cemented carbide used for this invention, and is governed by it, and bonding strength.

[0033] Moreover, still higher bonding strength can be obtained by setting thickness of the above-mentioned junction medium to 0.005-1mm. That is, the fracture from the part of a junction medium and alternative wear of the part of a junction medium can be prevented, and the honeycomb structure object molding die excellent in endurance can be obtained.

[0034] When the thickness of the above-mentioned junction medium is less than 0.005mm, it is necessary to set flatnes of the junction interface of the metal mold material comrade who faces which it is going to join to less than 0.005mm. When the honeycomb structure object molding die of the magnitude which this manufactures by this invention explained in full detail behind is manufactured, because of the area takes time amount and time and effort remarkably, and it is inferior to economical efficiency. Moreover, when less than 0.005mm is not made to the above-mentioned

flatness, adhesion of a junction interface comrade is barred, junction of a metal mold material becomes difficult, and there is a possibility that sufficient bonding strength cannot be obtained. On the other hand, when extrusion molding of the ingredient which constitutes fracture by the stress concentration to the part of a junction medium and a honeycomb structure object when the above-mentioned thickness exceeds 1mm is carried out, the part of a junction medium is alternatively worn out, and in being the worst, there is a possibility of producing fracture from the part of a junction medium.

[0035] Next, as for the above-mentioned 1st metal mold material, the 2nd metal mold material, and an owner hole meta mold material, consisting of cemented carbide is desirable like invention according to claim 11. Thereby, maintenance of dimensional accuracy can be ensured [easily and] in junction of each metal mold material. The above-mentioned cemented carbide means the hard sintered alloy which blended and sintered metallic carbide powder and metal powder. As the above-mentioned cemented carbide, tungsten carbide (WC) is used as a principal component, and there is a sintered metal which it comes to harden with cobalt (Co), for example.

[0036] Next, the thing of iron, cobalt, and nickel which the metal more than a kind is added 3 to 30% at least, and the above-mentioned cemented carbide considers as a sintered alloy to the carbide powder of the metal belonging to periodic table the 4a, 5a, and 6a group which consists of carbide of the metal more than a kind at least is desirable like invention according to claim 12. That is, to the carbide powder which consists of carbide of the metal more than a kind at least among Ti, V, Cr, Zr, Nb, Mo, Hf, Ta, and W, the above-mentioned cemented carbide is obtained by [of iron cobalt, and nickel] adding and sintering more than a kind at least so that a content may become 3 - 30%.

[0037] Thereby, processing of the above-mentioned slit slot and junction of each metal mold material can be ensured [still more easily and]. Moreover, when adding each metal of the above-mentioned iron, cobalt, and nickel independently, the content is 3 - 30%, and when adding the metal whose number is [two or more], the content of the sum total is 3 - 30%.

[0038] The material proof stress in the high temperature region at the time of carrying out junction processing of the metal mold material is influenced directly, and maintenance of the dimensional accuracy of the above-mentioned primary slot already formed before junction is influenced greatly. Moreover, diffusibility with a junction medium is als influenced and junction nature and bonding strength are also influenced. That is, when the above-mentioned content exceeds 30%, the material proof stress in the pyrosphere used for junction which is explained in full detail behind is low, the dimension of the above-mentioned primary slot etc. changes with the pressurization for raising the adhesion explained in full detail to the material self-weight at the time of junction, or the back, and there is a possibility that it may not be materialized as a mold. On the other hand, when the above-mentioned content is less than 3%, there is a possibility that the diffusibility of a junction medium and each metal mold material may fall, and junction nature and bonding strength may fall. Moreover, in order that toughness becomes low in this case, it may be easy to damage in cas it is used as metal mold, and crack propagation nature may also go up, handling takes cautions extremely.

[0039] Next, while the 1st metal mold material which formed the slit slot which the shape of a honeycomb penetrated like invention according to claim 13, and the owner hole metal mold material which has a supply hole for supplying an ingredient come to join, there is a honeycomb structure object molding die characterized by the above-mentioned slit slot and the above-mentioned supply hole coming to be open for free passage.

[0040] In the above-mentioned honeycomb structure object molding die, the above-mentioned slit slot is open for free passage in the direct above-mentioned supply hole. So, in fabricating a honeycomb structure object using the above-mentioned honeycomb structure object molding die, the ingredient supplied to the above-mentioned supply hole is directly supplied to the above-mentioned slit slot. That is, the ingredient supplied to the above-mentioned supply hole is supplied to the direct above-mentioned slit slot in the condition [that there has been a fluidity]. Therefore, an ingredier does not have a possibility that fault, like homogeneity is supplied throughout the above-mentioned slit slot, and the honeycomb structure object fabricated is distorted may arise.

[0041] Next, as for the above-mentioned 1st metal mold material, the 2nd metal mold material, and an owner hole meta mold material, consisting of cemented carbide is desirable like invention according to claim 14. Thereby, maintenance of dimensional accuracy can be ensured [easily and] in junction of each metal mold material.

[0042] Next, the thing of iron, cobalt, and nickel which the metal more than a kind is added 3 to 30% at least, and the above-mentioned cemented carbide considers as a sintered alloy to the carbide powder of the metal belonging to periodic table the 4a, 5a, and 6a group which consists of carbide of the metal more than a kind at least is desirable like invention according to claim 15. honeycomb structure object molding to which the above-mentioned slit slot was formed in much more certainly, and each metal mold material was joined much more certainly by this -- public funds -- a mold can be obtained.

[0043] Next, it is desirable like invention according to claim 16 to make a junction medium have intervened between th

above-mentioned 1st metal mold material and the above-mentioned 2nd metal mold material and between the above-mentioned 1st metal mold material and the above-mentioned owner hole metal mold material. honeycomb structure object molding to which each metal mold material was joined much more certainly by this -- public funds -- a mold can be obtained.

[0044] Next, like invention according to claim 17, join to a metal mold material by thermal diffusion or soldering, and the above-mentioned junction medium forms a metallic foil, it comes to form in the above-mentioned metal mold material by plating or vacuum evaporationo, and, as for the thickness of the above-mentioned junction medium, it is desirable that it is 0.005-1mm. Here, the above-mentioned metal mold material means the above-mentioned 1st metal mold material, the 2nd metal mold material, an owner hole metal mold material, or a non-hole metal mold material. Thereby, junction for the above-mentioned 1st metal mold material and the above-mentioned 2nd metal mold material or junction for the above-mentioned 1st metal mold material and the above-mentioned owner hole metal mold material can be ensured [still more easily and]. As for the above-mentioned metallic foil, it is desirable that it is the metal or alloy which uses gold, silver, copper, nickel, etc. as a principal component from a viewpoint of junction nature and bonding strength. A critical meaning of the thickness of the above-mentioned junction medium is the same as that of the case of invention of above-mentioned claim 10.

[0045]

[Embodiment of the Invention] It explains using drawing 1 - drawing 3 about the manufacture approach of the honeycomb structure object molding die concerning the example of an operation gestalt of example of operation gestalt 1 this invention. The honeycomb structure object molding die 1 manufactured in this example has the slit slot 15 for it being open for free passage in the supply hole 131 and this supply hole 131 for supplying an ingredient, and fabricating an ingredient in a honeycomb configuration, as shown in drawing 2 .

[0046] The above-mentioned manufacture approach consists of the 1st process - the 5th process, as shown in drawing 1 In drawing 1 , - (A-1) (E-1) is the perspective view which turned the top face of the 1st processing object - 4th processing object and a honeycomb structure object molding die up, and - (A-2) (E-2) is the perspective view which turned the inferior surface of tongue up.

[0047] that is, mutually-independent [for the 1st metal mold material 11] in the 1st process -- the bottom -- many -- the penetrated primary slot 115 of several articles is formed by the wire electron discharge method, and primary processing objects 101 are acquired (drawing 1 (A-1), (A-2)). Subsequently, in the 2nd process, the 2nd metal mold material 12 is joined to the top face of the primary above-mentioned processing objects 101, and the secondary elaboration object 102 is acquired (drawing 1 (B-1), (B-2)).

[0048] subsequently, mutually-independent [on the above-mentioned secondary elaboration object 102] in the 3rd process -- the bottom -- many -- the penetrated secondary slot 125 of several articles is formed by the wire electron discharge method, and the 3rd processing object 103 is acquired (drawing 1 (C-1)). Under the present circumstances, the honeycomb slit slot 15 on the above formed when the above-mentioned secondary slot 125 is open for free passage with the above-mentioned primary slot 115 is formed in the above-mentioned 1st metal mold material 11 (drawing 1 (C-2), drawing 3 (C)).

[0049] Subsequently, in the 4th process, the owner hole metal mold material 13 which has the above-mentioned supply hole 131 is joined to the inferior surface of tongue of the above-mentioned 1st metal mold material 11, and the 4th processing object 104 is acquired (drawing 1 (D-1), (D-2)). Subsequently, in the 5th process, the honeycomb structure object molding die 1 is obtained by removing the 2nd metal mold material 12 from the above-mentioned 4th processing object 104 (drawing 1 (E-1), (E-2)).

[0050] In addition, in the 1st process of the above, and the 3rd process, in forming the primary slot 115 and the secondary slot 125, the through hole of a minor diameter is prepared in the 1st metal mold material 11 or the secondary elaboration object 102, and it lets a wire electrode pass to this through hole. And an electron discharge method is carried out, moving this wire electrode relatively. As 1st metal mold material 11 grade does not dissociate by formation of the above-mentioned primary slot 115 grade, only an edge is for leaving without processing it.

[0051] Moreover, in the 2nd process of the above, and the 4th process, the 1st metal mold material 11, the 2nd metal mold material 12, or the 1st metal mold material 11 and the owner hole metal mold material 13 is joined by the diffusio welding method. Moreover, in the 5th process of the above, removal of the 2nd metal mold material 12 is performed by carrying out surface grinding using a surface grinder.

[0052] Next, it explains per operation effectiveness of this example. In the manufacture approach of the above-mentioned honeycomb structure object molding die 1 after joining the direct above-mentioned owner hole metal mold material 13 to the inferior surface of tongue of the above-mentioned 1st metal mold material 11 in which the honeycom slit slot 15 on the above was formed like the above, the 2nd metal mold material 12 joined to the top face of the above-

mentioned 1st metal mold material 11 is removed (drawing 1 (D-1), (D-2), and (E-1) --) (E-2).
[0053] Therefore, the above-mentioned slit slot 15 of the honeycomb structure object molding die 1 obtained by the above-mentioned manufacture approach is connected with the direct above-mentioned supply hole 131 as shown in drawing 3 (A). So, the ingredient supplied to the above-mentioned supply hole 131 shown in drawing 3 (B) as a continuous line is directly supplied to the above-mentioned slit slot 15 shown in drawing 3 (C) as a continuous line in shaping of a honeycomb structure object. That is, the ingredient supplied to the above-mentioned supply hole is supplie to the direct above-mentioned slit slot in the condition [that there has been a fluidity]. Thereby, an ingredient is supplied to homogeneity throughout the above-mentioned slit slot 15. Therefore, there is no possibility that fault, like the honeycomb structure object fabricated is distorted may arise.
[0054] In addition, drawing 3 (D) is D-D line view sectional view of drawing 1 (D-2), and since it is a thing in the middle of manufacture of the honeycomb structure object molding die 1, the cross section shown in this drawing does not exist in the completed honeycomb structure object molding die 1. Moreover, since the 5th process of the above removes the 2nd metal mold material 102 with surface grinding, it can remove easily the above-mentioned 2nd metal mold material 102.
[0055] According to this example, like the above, the honeycomb structure object molding die which can fabricate the honeycomb structure object which faults, such as distortion, do not generate can be manufactured using a wire electron discharge method.
[0056] The example of two examples of an operation gestalt shows the more concrete example of the honeycomb structure object molding die of the example 1 of an operation gestalt, and its manufacture approach, as shown in drawing 4 . The honeycomb structure object molding die 1 of this example consists of an owner hole metal mold material 13 of a rectangular plate, and the 1st metal mold material 11 of a circular plate, as shown in drawing 4 (A). Th above-mentioned owner hole metal mold material 13, the 1st metal mold material 11, and the below-mentioned 2nd metal mold material consist of a ferrous material for metal mold.
[0057] Moreover, the appearance of the above-mentioned owner hole metal mold material 13 is determined based on th attachment dimension to a making machine, and the owner hole metal mold material 13 of this example is 200mm around. On the other hand, the above-mentioned 1st metal mold material 11 is about 130mm in diameter. Moreover, th thickness of the above-mentioned honeycomb structure object molding die 1 is about 20mm.
[0058] As shown in the above-mentioned 1st metal mold material 11 at drawing 4 (C), the slit slot 15 of the honeycomb configuration of many hexagons is formed. The flute width of this slit slot 15 is 0.1mm. On the other hand, corresponding to the intersection of the above-mentioned slit slot 15, many supply holes 131 with a diameter of 1.0mm for ingredient supply are established in the above-mentioned owner hole metal mold 13 (broken line of drawing 4 (C)). This supply hole 131 is open for free passage into the above-mentioned slit slot 15, and the ingredient supplied from th above-mentioned supply hole 131 is supplied to the above-mentioned slit slot 15. In addition, in drawing 4 (A), a sign 139 is an attaching hole for attaching the above-mentioned honeycomb structure object molding die 1 in a making machine.
[0059] The manufacture approach of the above-mentioned honeycomb structure object molding die 1 is the same as the manufacture approach shown in the above-mentioned example 1 of an operation gestalt fundamentally. In this example in the 1st process shown in the example 1 of an operation gestalt, the primary slot of the configuration of the abbreviation one half of the honeycomb of the above-mentioned hexagon is formed in the above-mentioned 1st metal mold material 11 of a circular plate by the wire electron discharge method using a tungsten wire electrode with a diameter of 0.07mm. Moreover, in the 2nd process, the 2nd metal mold material is joined to the primary above-mentioned processing objects using a diffusion welding method. Moreover, in the 3rd process, a secondary slot is formed by the same wire electron discharge method as the above.
[0060] In the 4th process, the owner hole metal mold material 13 of the rectangular plate which established the supply hole 131 in the inferior surface of tongue of the above-mentioned 1st metal mold material 11 beforehand is joined by th diffusion welding method, and a 4th processing object is acquired. Subsequently, in the 5th process, surface grinding o the 2nd metal mold material of the above-mentioned 4th processing object is carried out with a surface grinder, and it i removed. This obtains the honeycomb structure object molding die 1 shown in drawing 4 (A) and (B). Others are the same as that of the example 1 of an operation gestalt. Also in this example, it has the same operation effectiveness as th example 1 of an operation gestalt.
[0061] In addition, in this example, although the slit slot with a flute width of 0.1mm was formed using the wire electrode with a diameter of 0.07mm, the diameter of the above-mentioned wire electrode can be made still smaller, fo example, the still thinner slit slot of 0.075mm and 0.05mm can also be formed. Moreover, as the above-mentioned owner hole metal mold material, the 1st metal mold material, and the 2nd metal mold material, although the ferrous

material for metal mold was used, other ingredients, such as a sintered metal, may be used.
[0062] Moreover, in the 2nd process and the 4th process of the above-mentioned example 1 of an operation gestalt, and the example 2 of an operation gestalt, although the diffusion welding method was used for junction of the 1st metal mold material, the 2nd metal mold material or the 1st metal mold material, and an owner hole metal mold material, other junction approaches, such as the soldering method and the pasting-up method, can also be used, for example.
[0063] the example of three examples of an operation gestalt is shown in drawing 5 -- as -- the 1st process and the 3rd process -- setting -- many -- it is the example which is made to connect in picture drawn without lifting the brush from the paper, and is formed, without carrying out mutually-independent [of the primary slot 115 of several articles, and the secondary slot 125]. That is, to that in which the primary slot and secondary slot of the above-mentioned example 1 of an operation gestalt are carrying out mutually-independent (drawing 1 (A-1), (C-1)), the primary slot 115 and the secondary slot 125 of this example are connected by the connection slot 116,126, as shown in drawing 5 (A-1) and (C-1).
[0064] in the 1st process, the manufacture approach of the honeycomb structure object molding die 1 of this example was connected with the 1st metal mold material 11 in picture drawn without lifting the brush from the paper, as shown in drawing 5 (A-1) and (A-2) -- many -- the penetrated primary slot 115 of several articles is formed by the wire electron discharge method.
[0065] moreover, in the 3rd process, it connected with the secondary elaboration object 102 (drawing 5 (B-1), (B-2)) in picture drawn without lifting the brush from the paper -- many -- the penetrated secondary slot 125 of several articles is formed by the wire electron discharge method (drawing 5 (C-1)). Under the present circumstances, for the above-mentioned 1st metal mold material 11, the 3rd processing object 103 is acquired by forming the honeycomb slit slot 15 on the above formed when the above-mentioned secondary slot 125 is open for free passage with the above-mentioned primary slot 115 (drawing 5 (C-2)).
[0066] In addition, about the 2nd process other than the 1st process of the above, and the 3rd process, the 4th process, and the 5th process, it is the same as that of the example 1 of an operation gestalt. Moreover, drawing 5 (D-1) and (D-2) express the 4th processing object 104 acquired according to the 4th process, and drawing 5 (E-1) and (E-2) express the honeycomb structure object molding die 1 finally obtained.
[0067] the manufacture approach of the honeycomb structure object molding die 1 of this example was connected with the 1st metal mold material 11 or the 2nd metal mold material 102 in picture drawn without lifting the brush from the paper in the 1st process and the 3rd process -- many -- the penetrated primary slot 115 of several articles or the secondary slot 125 is formed (drawing 5 (A-1), (A-2), (C-1)).
[0068] Therefore, it is not necessary to prepare many through holes of the minor diameter used as the starting point at the time of carrying out a wire electron discharge method. That is, it is sufficient if one place is prepared in the 1st metal mold material 11 at one place and the secondary elaboration object 102, respectively. Moreover, whenever it processes the primary slot 115 or the secondary slot 125 one articles, it is not necessary to **********. Therefore, a honeycomb structure object molding die can be manufactured with much more sufficient productive efficiency. In addition, it has the same operation effectiveness as the example 1 of an operation gestalt.
[0069] In addition, in the 5th process of the above-mentioned examples 1-3 of an operation gestalt, although the surface grinding which used the surface grinder performed removal of the 2nd metal mold material, it is removable by other approaches, such as a wire electron discharge method. Furthermore, the configuration of the honeycomb of the above-mentioned slit slot can also make other configurations not only a hexagon but a square, a round shape, etc.
[0070] The example of four examples of an operation gestalt is an example which performs junction for the 1st metal mold material 11 and the 2nd metal mold material 12, and junction for the 1st metal mold material 11 and the owner hole metal mold material 13 by making the junction medium 21 or 22 placed between planes of composition, as shown in drawing 6 - drawing 8 . In drawing 6 - drawing 8 , a plan - (A-2) (F-2) a bottom view, and - (A-3) (F-3) of - (A-1) (F-1) are the explanatory views of a J-J line view cross section of - (A-1) (F-1) or (A-2) - (F-2).
[0071] honeycomb structure object molding of this example -- public funds -- it explains about the manufacture approach of a mold using drawing 6 - drawing 8 . First, in the 1st process, as shown in drawing 6 (A-1), (A-2), and (A-3), the primary slot 115 is formed in the 1st metal mold material 11, and primary processing objects 101 are acquired. The above-mentioned 1st metal mold material 11 consists of cemented carbide. It is the sintered metal which this cemented carbide uses tungsten carbide (WC) as a principal component, and it comes to harden with cobalt, and a cobalt content is about 12%. Moreover, the 2nd metal mold material 12 and the owner hole metal mold material 13 also consist of same cemented carbide.
[0072] Subsequently, in the 2nd process, as shown in drawing 6 (B-1), (B-2), and (B-3), the junction medium 21 which consists of a nickel (nickel) foil is made to be placed between the top faces of the above-mentioned 1st metal mold

material 11, and the above-mentioned 2nd metal mold material 12 is joined. In order to raise adhesion in junction, about 0.2mm or less is made to the flatness of each metal mold material and the junction medium 21. And the above-mentioned junction medium 21 is made to be placed between the planes of composition of the above-mentioned 1st metal mold material 11 and the 2nd metal mold material 12, and it heats with about [of the creep temperature of this junction medium 21, i.e., peculiar melting temperature, / 1/2 or more], and under melting temperature. Moreover, in order not to make a junction interface generate an oxide and to evaporate the adhering oxide in the vapor pressure of a proper, it heats in a vacuum ambient atmosphere. Moreover, in order to raise the adhesion of a junction interface, it pressurizes at the time of a temperature up or a temperature fall. However, max is also considered as the pressurization of 100 or less MPas from a viewpoint of the maintenance of dimensional accuracy influenced by the elevated-temperature proof stress of a metal mold material.

[0073] This acquires the secondary elaboration object 102. Moreover, thickness of the above-mentioned junction medium 21 is set to about 50 micrometers from a viewpoint of bonding strength. Moreover, since the above-mentioned junction medium 21 is annealed under a high temperature service like the above, it does not pose especially a problem about the hardness. For example, as hardness of the above-mentioned junction medium 21, if it is the thing of 1 / 4 H-H material, it is enough.

[0074] Subsequently, in the 3rd process, as shown in drawing 7 (C-1), (C-2), and (C-3), the secondary slot 125 is formed in the above-mentioned secondary elaboration object 102, and the 3rd processing object 103 is acquired. The honeycomb-like slit slot 15 is formed in the above-mentioned 1st metal mold material 11 at this time (drawing 7 (C-2)).

[0075] Subsequently, in the 4th process, as shown in drawing 7 (D-1), (D-2), and (D-3), the junction medium 22 is mad to be placed between the inferior surfaces of tongue of the above-mentioned 1st metal mold material 11, and the above-mentioned owner hole metal mold material 13 is joined. This junction medium 22 and the junction approach are the same as the junction medium 21 and the junction approach which were used in the 2nd process. This acquires the 4th processing object 104. At this time, the above-mentioned slit slot 15 is blockaded by the above-mentioned junction medium 22 from the inferior surface of tongue of the 1st metal mold material 11, and the above-mentioned supply hole 131 is also blockaded by the above-mentioned junction medium 22 from the top face of the above-mentioned owner hole metal mold material 13 (drawing 7 (D-3)). Therefore, the above-mentioned supply hole 131 and the slit slot 15 ar in the condition of not being open for free passage.

[0076] Subsequently, in the 5th process, as shown in drawing 8 (E-1), (E-2), and (E-3), the 2nd metal mold material 12 and the junction medium 21 of the inferior surface of tongue are removed from the above-mentioned 4th processing object 104. Subsequently, for example, fluid polish removes alternatively the junction medium 22 which has checked the free passage with the above-mentioned supply hole 131 and the slit slot 15. this shows drawing 8 (F-1), (F-2), and (F-3) -- as -- the above-mentioned supply hole 131 and the slit slot 15 -- open for free passage -- honeycomb structure object molding -- public funds -- a mold 1 is completed. Others are the same as that of the example 1 of an operation gestalt.

[0077] In this example, since the above-mentioned junction media 21 and 22 are used, junction for the 1st metal mold material 11 and the 2nd metal mold material 12 and junction for the 1st metal mold material 11 and the owner hole metal mold material 13 can be ensured [easily and]. Moreover, since the above-mentioned junction media 21 and 22 consist of a nickel foil, junction for the 1st metal mold material 11 and the 2nd metal mold material 12 and junction fo the 1st metal mold material 11 and the owner hole metal mold material 13 can be ensured [still more easily and]. Moreover, since thickness of the above-mentioned junction media 21 and 22 is set to about 50 micrometers, higher bonding strength can be obtained.

[0078] Moreover, since a cobalt content consists of cemented carbide which is about 12%, the material proof stress in the pyrosphere used for junction is also secured enough, and the above-mentioned 1st metal mold material 11, the 2nd metal mold material 12, and the owner hole metal mold material 13 can ensure [easily and] maintenance of dimensional accuracy in junction of each metal mold material. Moreover, since it also has toughness moderately, in ca it is used as metal mold, it is hard to damage, and cautions special to the handling of a honeycomb structure object molding die are not required. In addition, it has the same operation effectiveness as the example 1 of an operation gestalt.

[0079] The example of five examples of an operation gestalt is an example which joins the junction media 21 and 22 t both sides of the 1st metal mold material 11 beforehand, as shown in drawing 9 - drawing 11 . And the primary slot 11 is formed in the above-mentioned 1st metal mold material 11 and the above-mentioned junction media 21 and 22 at coincidence (drawing 9 (B-3)), and the secondary slot 125 is formed in the secondary elaboration object 102 and the above-mentioned junction media 21 and 22 at coincidence (drawing 10 (D-3)). In drawing 9 - drawing 11 , a plan - (A

2) (F-2) a bottom view, and - (A-3) (F-3) of - (A-1) (F-1) are the explanatory views of a K-K line view cross section of (A-1) (F-1) or (A-2) - (F-2).

[0080] honeycomb structure object molding of this example -- public funds -- it explains about the manufacture approach of a mold using drawing 9 - drawing 11 . First, in the 1st process, as shown in drawing 9 (A-1), (A-2), and (A 3), the junction media 21 and 22 are joined to both sides of the 1st metal mold material 11, and as shown in drawing 9 (B-1), (B-2), and (B-3), the primary slot 115 is formed. At this time, this primary slot 115 is formed in the junction media 21 and 22 joined to the above-mentioned metal mold material 11 by those both sides at coincidence. This acquires primary processing objects 101. The quality of the material of the above-mentioned 1st metal mold material 11 the 2nd metal mold material 12, and the owner hole metal mold material 13 and also the quality of the material of the junction media 21 and 22, and thickness are the same as that of the case of the above-mentioned example 4 of an operation gestalt.

[0081] Subsequently, in the 2nd process, as shown in drawing 10 (C-1), (C-2), and (C-3), the above-mentioned 2nd metal mold material 12 is joined to the top face of the above-mentioned 1st metal mold material 11 through the above-mentioned junction medium 21. The junction approach at this time is the same as that of the case of the example 4 of an operation gestalt. This acquires the secondary elaboration object 102.

[0082] Subsequently, in the 3rd process, as shown in drawing 10 (D-1), (D-2), and (D-3), the secondary slot 125 is formed in the above-mentioned secondary elaboration object 102 including the junction media 21 and 22, and the 3rd processing object 103 is acquired. The honeycomb-like slit slot 15 is formed in the junction medium 22 of the above-mentioned 1st metal mold material 11 and its inferior surface of tongue at this time (drawing 10 (D-2)).

[0083] Subsequently, in the 4th process, as shown in drawing 11 (E-1), (E-2), and (E-3), the above-mentioned owner hole metal mold material 13 is joined to the inferior surface of tongue of the above-mentioned 1st metal mold material 11 through the junction medium 22. This junction approach is the same as that of the 2nd process. This acquires the 4th processing object 104.

[0084] Subsequently, in the 5th process, as shown in drawing 11 (F-1), (F-2), and (F-3), the 2nd metal mold material 1 and the junction medium 21 of the inferior surface of tongue are removed from the above-mentioned 4th processing object 104. the above -- honeycomb structure object molding -- public funds -- a mold 1 is completed. Others are the same as that of the example 4 of an operation gestalt.

[0085] In this case, the above-mentioned junction medium 22 does not remain between the slit slot 15 formed in the above-mentioned 1st metal mold material 11, and the supply hole 131 of the above-mentioned owner hole metal mold material 13. Therefore, it is not necessary to remove this junction medium 2 alternatively like [in the case of the example 4 of an operation gestalt]. so -- much more -- easy -- honeycomb structure object molding -- public funds -- a mold 1 can be manufactured. In addition, it has the same operation effectiveness as the example 4 of an operation gestalt.

[0086] The example of six examples of an operation gestalt is an example which joins the junction medium 22 to the t face of the owner hole metal mold material 13 beforehand, as shown in drawing 12 - drawing 15 . In drawing 12 - drawing 15 , a plan - (a-2) (F-2) a bottom view, and - (a-3) (F-3) of - (a-1) (F-1) are the explanatory views of a K-K lin view cross section of - (a-1) (F-1) or (a-2) - (F-2).

[0087] honeycomb structure object molding of this example -- public funds -- it explains about the manufacture approach of a mold using drawing 12 - drawing 15 . First, as shown in drawing 12 , the above-mentioned owner hole metal mold material 13 which joined the junction medium 22 beforehand is produced.

[0088] That is, as shown in drawing 12 (a-1), (a-2), and (a-3), the junction medium 22 is joined to the top face of the non-hole metal mold material 130 which is in the condition before the supply hole 131 formation in the above-mentioned owner hole metal mold material 13. Subsequently, as shown in drawing 12 (b-1), (b-2), and (b-3), the suppl hole 131 is formed in the above-mentioned non-hole metal mold material 130 and the junction medium 22 at coincidence. This obtains the owner hole metal mold material 13 which has the supply hole 131 in which the junction medium 22 was formed on the top face except the supply hole 131.

[0089] Moreover, there are also the following approaches as an approach of producing the above-mentioned owner ho metal mold material 13 which joined the junction medium 22 beforehand. Namely, the above-mentioned junction medium 22 forms the free passage hole in the supply hole 131 beforehand formed in the above-mentioned owner hole metal mold material 13, and the location open for free passage with at least 1 means of drilling, an electron discharge method, and press working of sheet metal, and joins it to the top face of the above-mentioned owner hole metal mold material 13. Or the joint material 22 in which the free passage hole was formed is made to intervene among both like t above before junction of the above-mentioned 1st metal mold material 11 and the above-mentioned owner hole metal mold material 13. The owner hole metal mold material 13 which has by this the supply hole 131 in which the junction

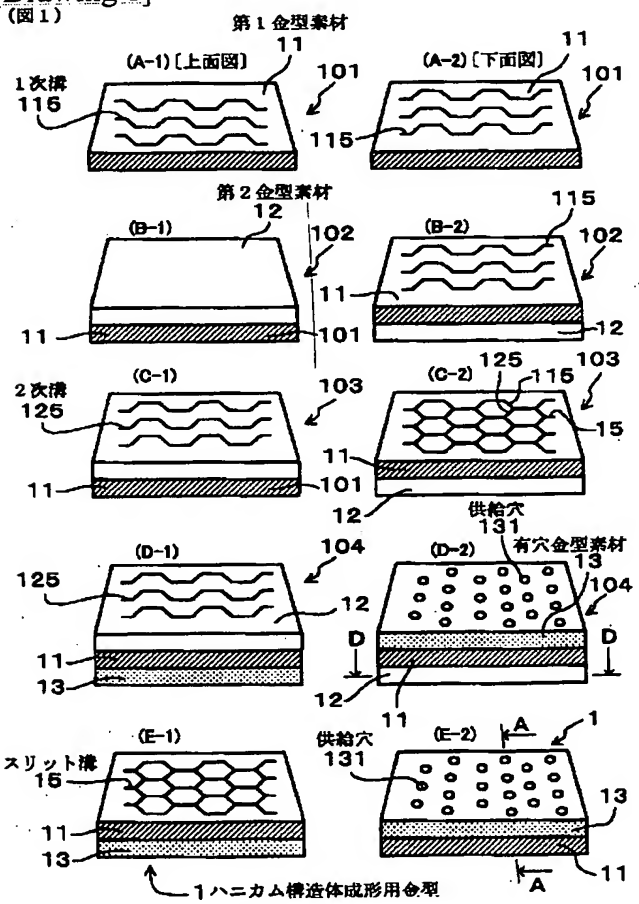
medium 22 was formed on the top face except the supply hole 131 is obtained.
[0090] In the 1st process of this manufacture approach, as shown in drawing 13 (A-1), (A-2), and (A-3), the junction medium 21 is joined to the top face of the 1st metal mold material 11, and as shown in drawing 13 (B-1), (B-2), and (B-3), the primary slot 115 is formed. At this time, this primary slot 115 is formed in the above-mentioned metal mold material 11 and the junction medium 21 joined to that top face at coincidence. This acquires primary processing objects 101. The quality of the material of the above-mentioned 1st metal mold material 11, the 2nd metal mold material 12, and the owner hole metal mold material 13 and also the quality of the material of the junction media 21 and 22, and thickness are the same as that of the case of the above-mentioned example 4 of an operation gestalt.
[0091] Subsequently, in the 2nd process, as shown in drawing 14 (C-1), (C-2), and (C-3), the above-mentioned 2nd metal mold material 12 is joined to the top face of the above-mentioned 1st metal mold material 11 through the above-mentioned junction medium 21. The junction approach at this time is the same as that of the case of the example 4 of an operation gestalt. This acquires the secondary elaboration object 102.
[0092] Subsequently, in the 3rd process, as shown in drawing 14 (D-1), (D-2), and (D-3), the secondary slot 125 is formed in the above-mentioned secondary elaboration object 102 including the junction medium 21, and the 3rd processing object 103 is acquired. The honeycomb-like slit slot 15 is formed in the above-mentioned 1st metal mold material 11 and the junction medium 21 at this time (drawing 14 (D-2)).
[0093] Subsequently, in the 4th process, as shown in drawing 15 (E-1), (E-2), and (E-3), the above-mentioned owner hole metal mold material 13 is joined to the inferior surface of tongue of the above-mentioned 1st metal mold material 11 through the junction medium 22. That is, the owner hole metal mold material 13 (drawing 12 (b-1), 2 [(b-2)], (b-3) produced beforehand in which the junction medium 22 was formed on the top face is joined to the inferior surface of tongue of the above-mentioned 1st metal mold material 11 like ****. This junction approach is the same as that of the 2nd process. This acquires the 4th processing object 104.
[0094] Subsequently, in the 5th process, as shown in drawing 15 (F-1), (F-2), and (F-3), the 2nd metal mold material 1 and the junction medium 21 of the inferior surface of tongue are removed from the above-mentioned 4th processing object 104. the above -- honeycomb structure object molding -- public funds -- a mold 1 is completed. Others are the same as that of the example 4 of an operation gestalt.
[0095] Also in this case, the above-mentioned junction medium 22 does not remain between the slit slot 15 formed in the above-mentioned 1st metal mold material 11, and the supply hole 131 of the above-mentioned owner hole metal mold material 13. Therefore, it is not necessary to remove this junction medium 2 alternatively like [in the case of the example 4 of an operation gestalt]. so -- much more -- easy -- honeycomb structure object molding -- public funds -- a mold 1 can be manufactured. In addition, it has the same operation effectiveness as the example 4 of an operation gestalt.

[Translation done.]

* NOTICES *

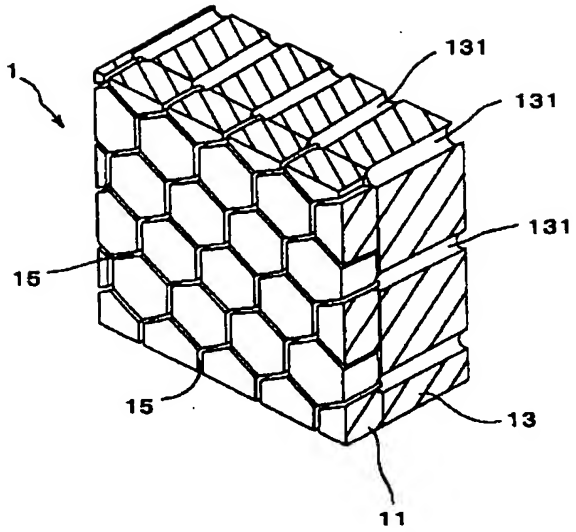
DRAWINGS

[Drawing 1]



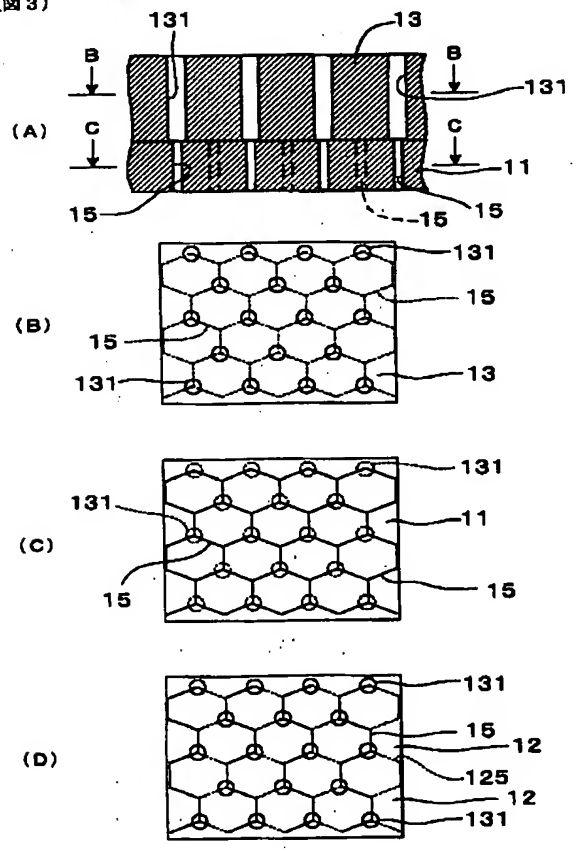
[Drawing 2]

(図2)



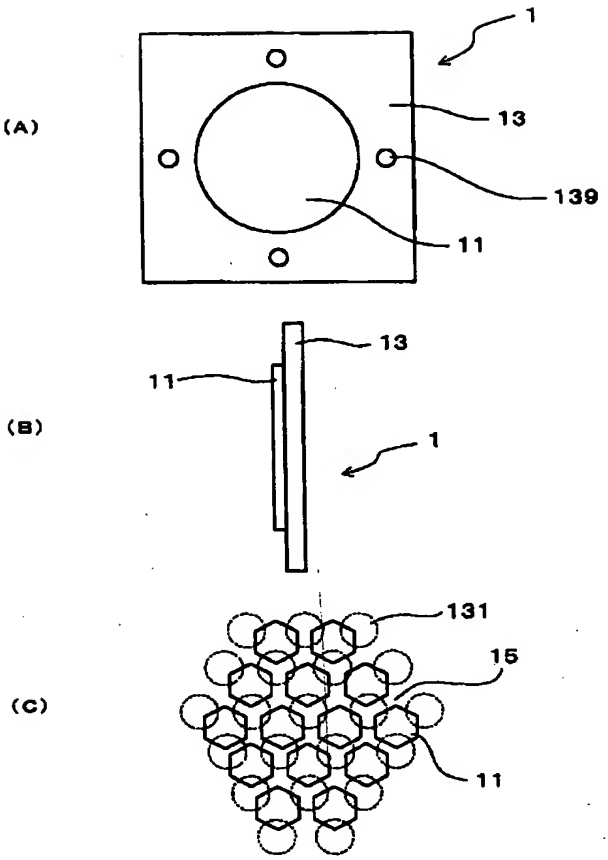
[Drawing 3]

(図3)

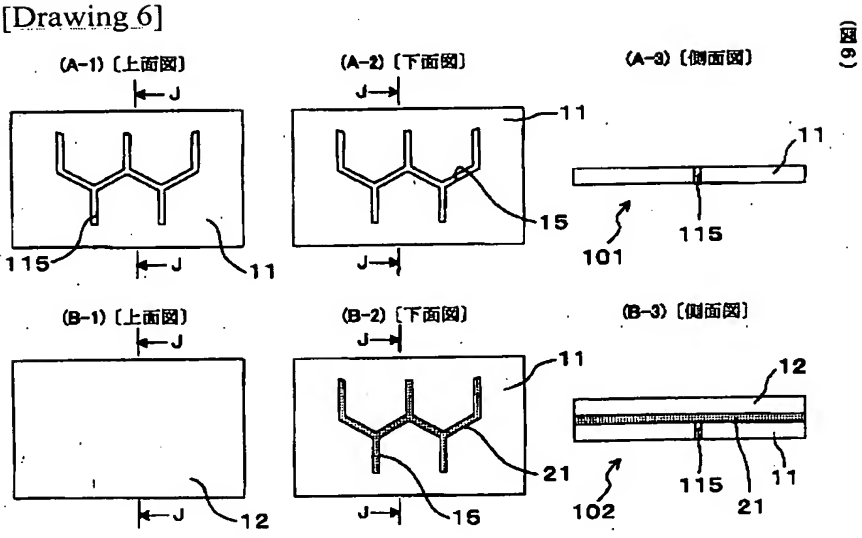


[Drawing 4]

(図4)



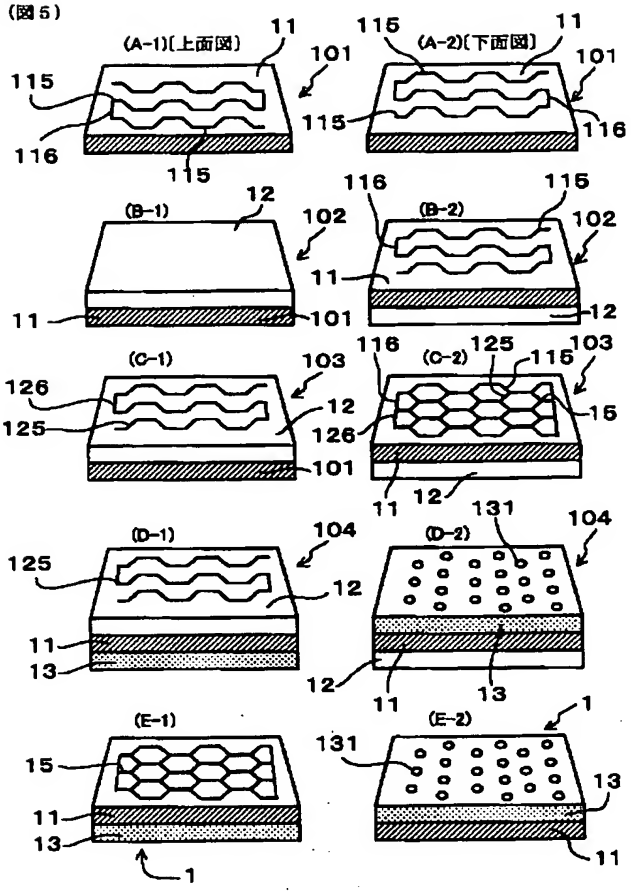
[Drawing 6]



(9図)

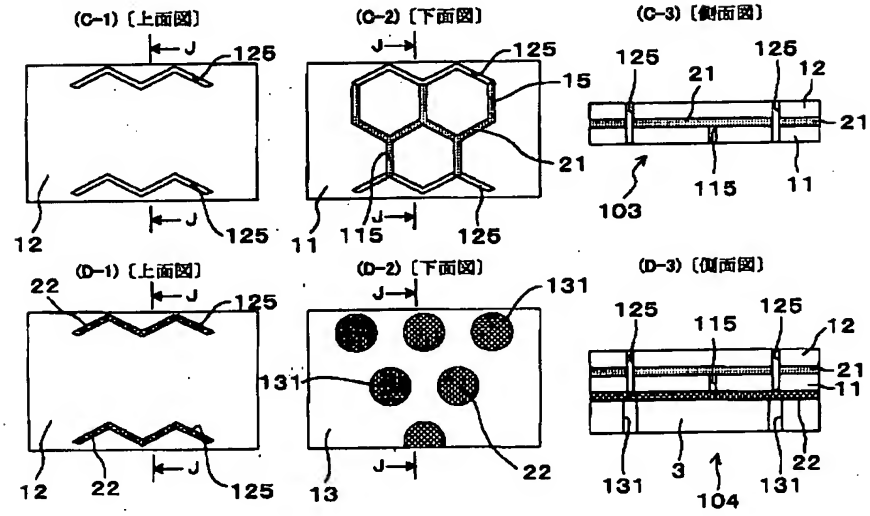
[Drawing 5]

(図5)



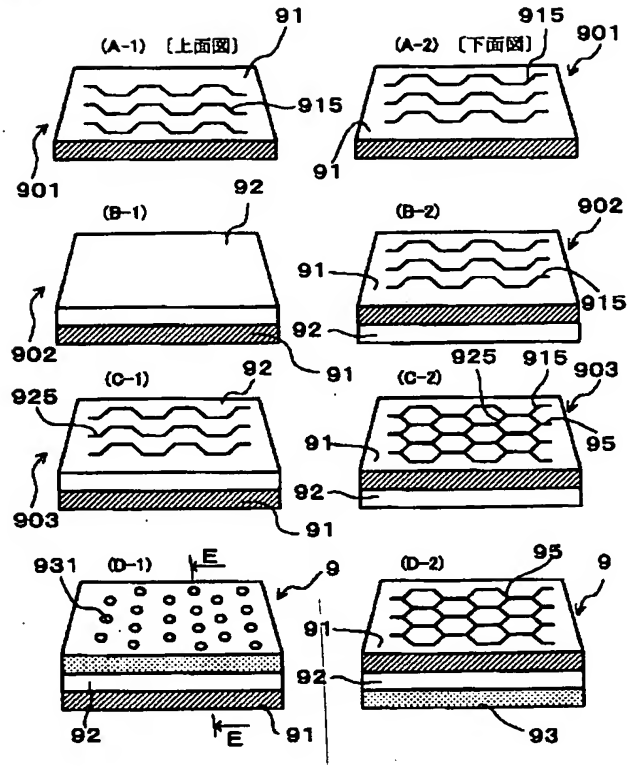
[Drawing 7]

(図7)

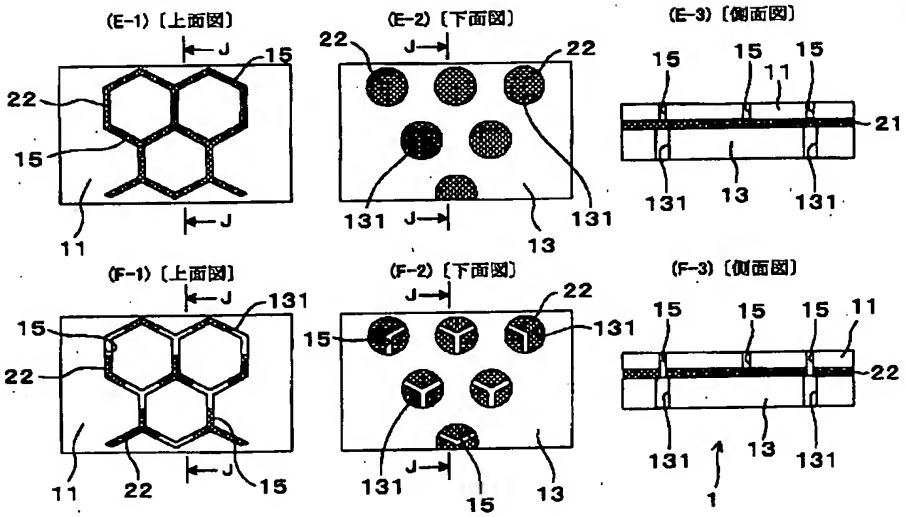


[Drawing 16]

(図16)



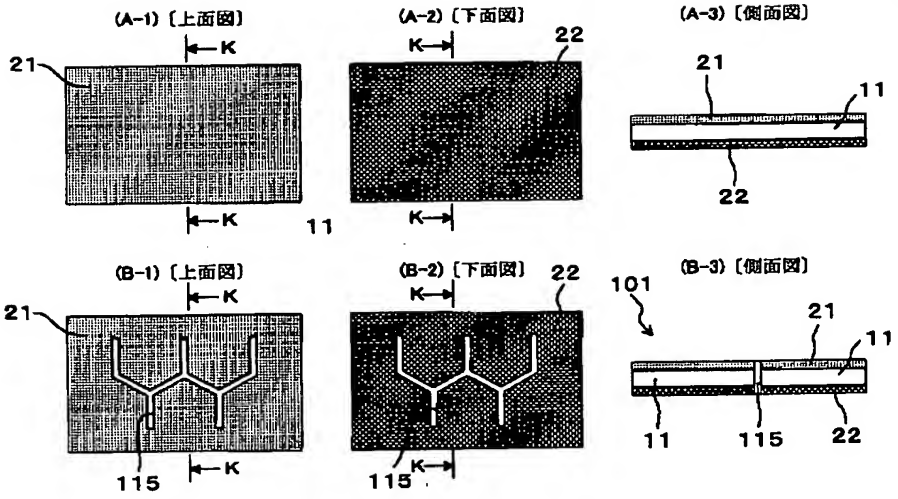
[Drawing 8]



(図8)

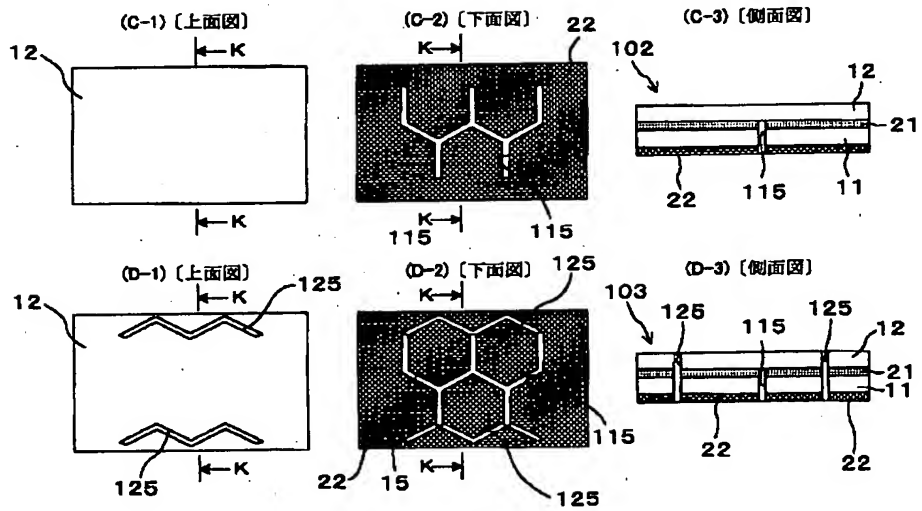
[Drawing 9]

(図9)



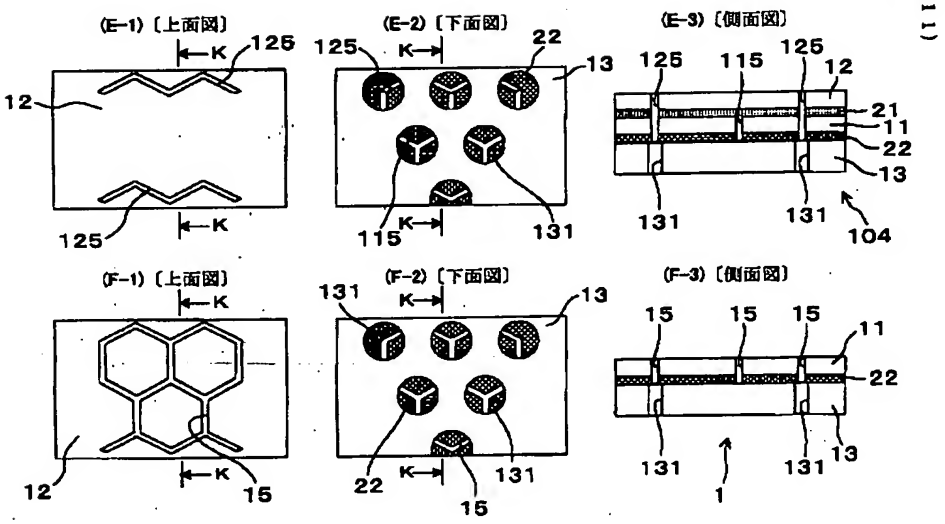
[Drawing 10]

(図10)



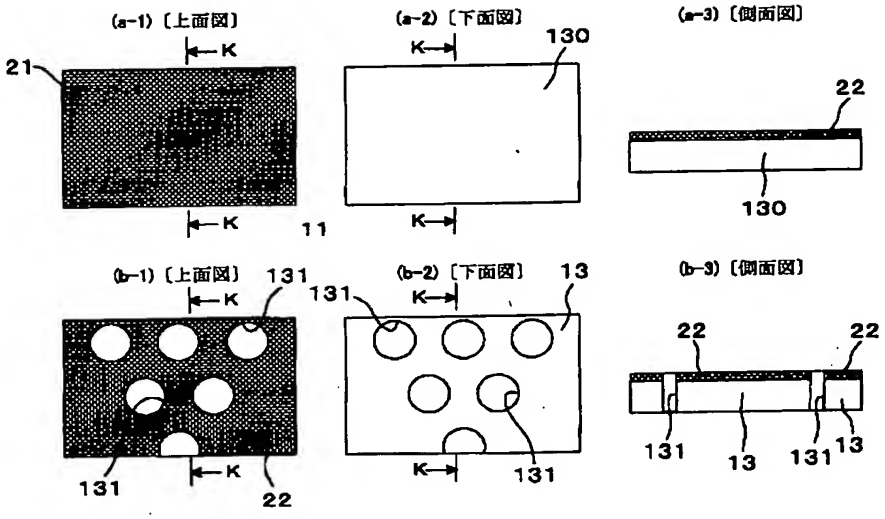
[Drawing 11]

(図11)



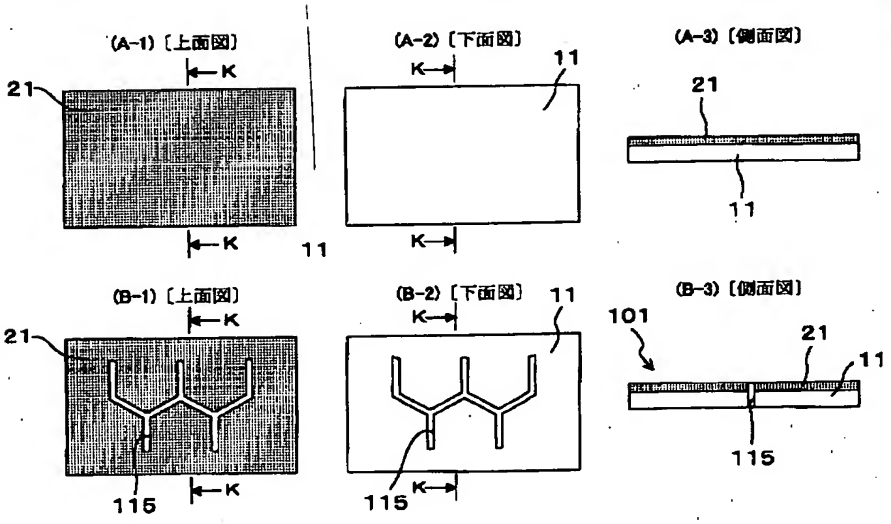
[Drawing 12]

(図12)



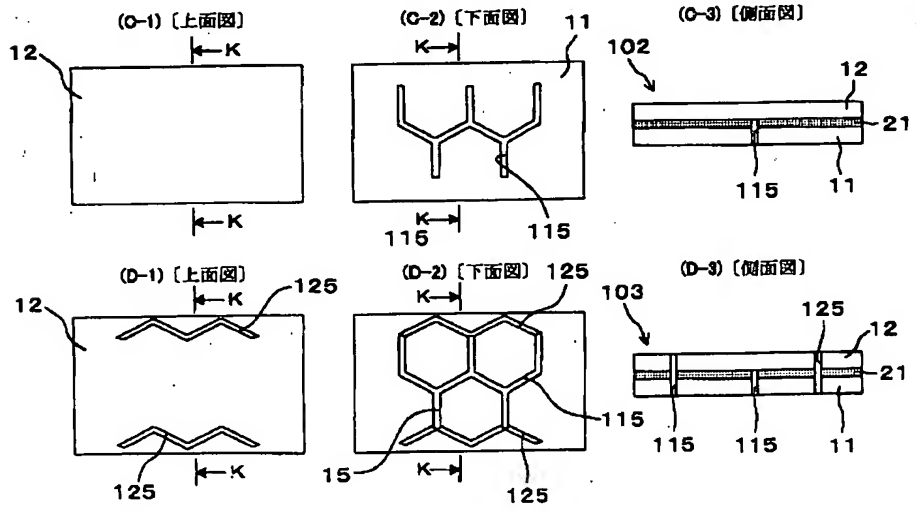
[Drawing 13]

(図13)



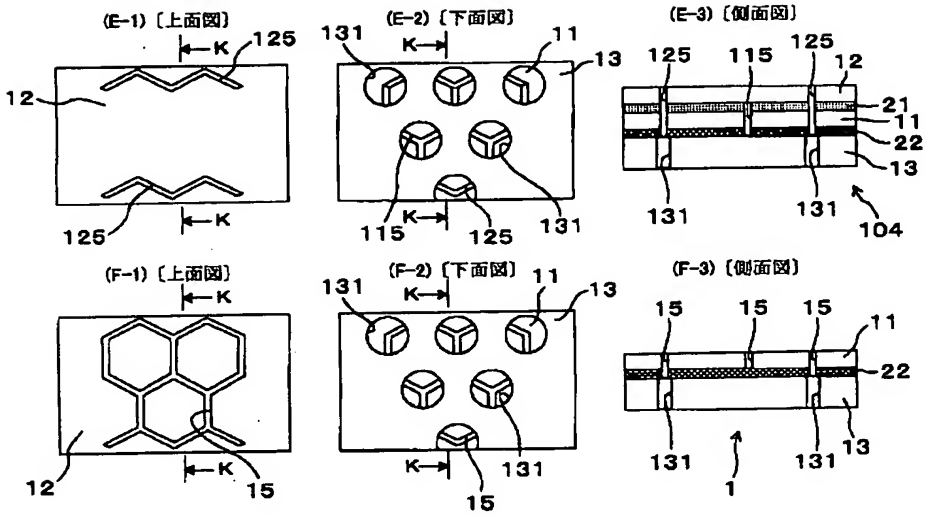
[Drawing 14]

(図14)



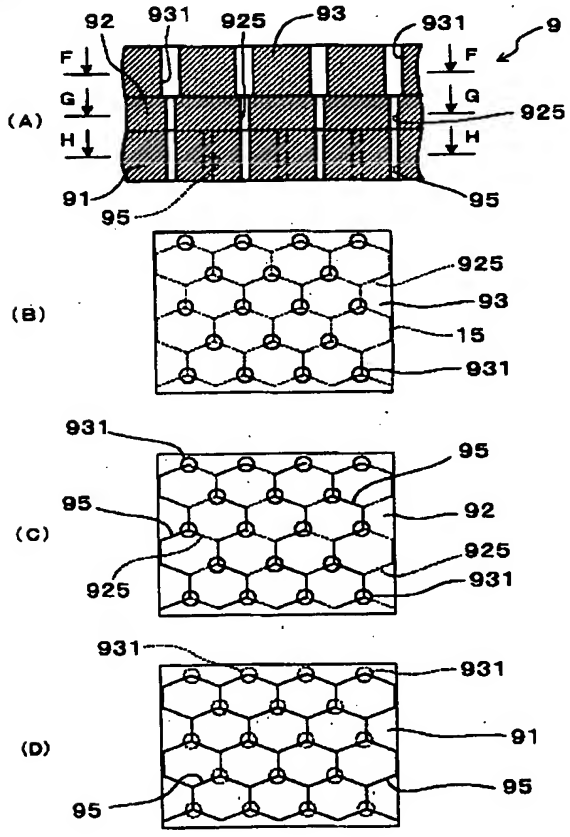
[Drawing 15]

(図16)



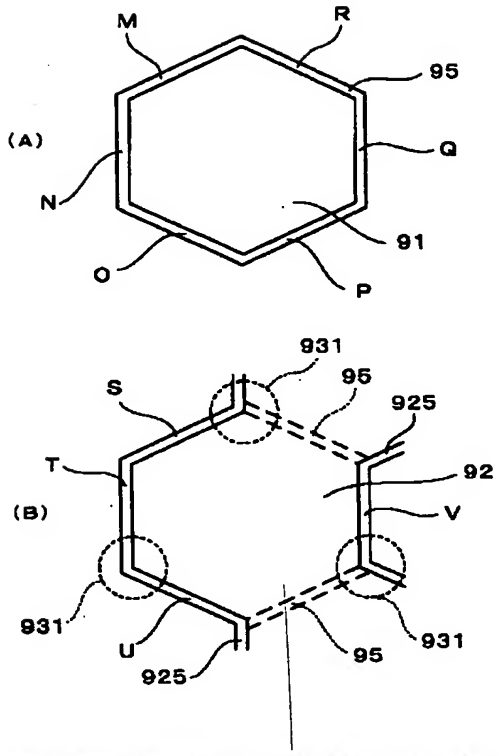
[Drawing 17]

(図17)



[Drawing 18]

(図18)



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(30)Priority
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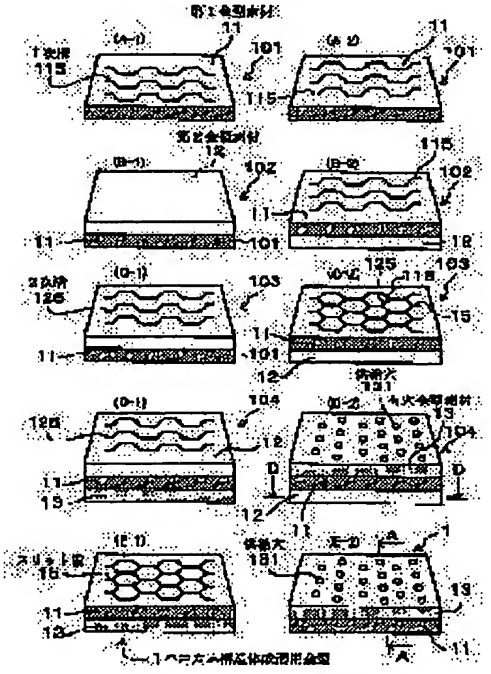
(54) DIE FOR MOLDING HONEYCOMB STRUCTURAL BODY AND MANUFACTURE THEREOF

(57)Abstract:
PROBLEM TO BE SOLVED: To manufacture a die for honeycomb structural body molding die, with which a honeycomb structural body can be molded without development of troubles such as strains or the like, by a wire electrical discharge machining.
SOLUTION: This die is for molding a honeycomb structural body having feeding holes 131, through which a material is fed, and slit grooves 15, which communicate with the feeding holes 131 so as to mold the material into a honeycomb shape. On a first die material 11, a large number of independent stripes of through primary-grooves 115 are formed by a wire electrical discharge machining. After a second die material 12 is bonded to the top surface of the first die material 11, similarly, secondary grooves 125 are formed. As a result, in the first die material 11, the secondary grooves 125 form a honeycomb-like slit groove 15 together with the primary grooves 115. After a holed die material 13 is bonded on the under surface of the first die material 11, the second die material 12 is removed.



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[Date of request for examination]
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29/08		29/08	

審査請求　未請求　請求項の数17　ＯＬ　（全 18 頁）　最終頁に続く

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(33)優先権主張国　日本（ＪＰ）

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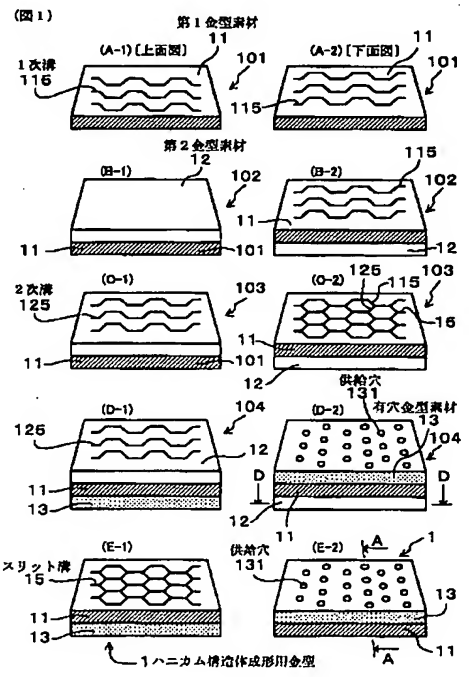
最終頁に続く

(54)【発明の名称】　ハニカム構造体成形用金型及びその製造方法

(57)【要約】
【課題】　歪み等の不具合が発生しないハニカム構造体を成形することができるハニカム構造体成形用金型を，ワイヤ放電加工を用いて製造することができるハニカム構造体成形用金型及びその製造方法を提供すること。
【解決手段】　材料を供給するための供給穴１３１と，供給穴１３１に連通し材料をハニカム形状に成形するためのスリット溝１５とを有するハニカム構造体成形用金型１を製造する方法。第１金型素材１１に互いに独立した多数条の貫通した１次溝１１５を，ワイヤ放電加工により形成する。その上面に第２金型素材１２を接合した後，同様に２次溝１２５を形成する。第１金型素材１１には２次溝１２５が１次溝１１５と共にハニカム状のスリット溝１５を形成する。有穴金型素材１３を第１金型素材１１の下面に接合した後，第２金型素材１２を除去する。

(図１)



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【特許請求の範囲】

【請求項１】　材料を供給するための供給穴と，該供給穴に連通し材料をハニカム形状に成形するためのスリット溝とを有するハニカム構造体成形用金型を製造する方法において，該製造方法は，第１金型素材に互いに独立した多数条の貫通した１次溝を，ワイヤ放電加工により形成して，１次加工体を得る第１工程と，第２金型素材を上記１次加工体の上面に接合して２次加工体を得る第２工程と，上記２次加工体に，互いに独立した多数条の貫通した２次溝を，ワイヤ放電加工により形成し，この際上記第１金型素材には上記２次溝が上記１次溝と連通することにより形成される上記ハニカム状のスリット溝を形成することにより，３次加工体を得る第３工程と，上記供給穴を有する有穴金型素材を上記第１金型素材の下面に接合して４次加工体を得る第４工程と，上記４次加工体から上記第２金型素材を除去する第５工程とからなることを特徴とするハニカム構造体成形用金型の製造方法。

【請求項２】　材料を供給するための供給穴と，該供給穴に連通し材料をハニカム形状に成形するためのスリット溝とを有するハニカム構造体成形用金型を製造する方法において，該製造方法は，第１金型素材に一筆書き的に連結した多数条の貫通した１次溝を，ワイヤ放電加工により形成して，１次加工体を得る第１工程と，第２金型素材を上記１次加工体の上面に接合して２次加工体を得る第２工程と，上記２次加工体に，一筆書き的に連結した多数条の貫通した２次溝を，ワイヤ放電加工により形成し，この際上記第１金型素材には上記２次溝が上記１次溝と連通することにより形成される上記ハニカム状のスリット溝を形成することにより，３次加工体を得る第３工程と，上記供給穴を有する有穴金型素材を上記第１金型素材の下面に接合して４次加工体を得る第４工程と，上記４次加工体から上記第２金型素材を除去する第５工程とからなることを特徴とするハニカム構造体成形用金型の製造方法。

【請求項３】　請求項１又は２において，上記第５工程は，第２金型素材を平面研削によって除去することを特徴とするハニカム構造体成形用金型の製造方法。

【請求項４】　請求項１又は２において，上記第５工程は，第２金型素材をワイヤーカットによって除去することを特徴とするハニカム構造体成形用金型の製造方法。

【請求項５】　請求項１～４のいずれか一項において，上記スリット溝は，四角形，六角形，又は円形のいずれかであることを特徴とするハニカム構造体成形用金型の製造方法。

【請求項６】　請求項１～５のいずれか一項において，上記第１金型素材と上記第２金型素材との接合，及び上記第１金型素材と上記有穴金型素材との接合は，接合面に接合媒体を介在させることにより行うことを特徴とするハニカム構造体成形用金型の製造方法。

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【請求項７】　請求項６において，上記接合媒体は，上記第１金型素材の両面に予め接合しておき，上記１次溝は，上記第１金型素材と上記接合媒体とに同時に形成し，また，上記２次溝は，上記第１金型素材と上記第２金型素材と上記接合媒体とに同時に形成することを特徴とするハニカム構造体成形用金型の製造方法。

【請求項８】　請求項６において，上記第１金型素材と上記有穴金型素材とを接合する上記接合媒体は，上記有穴金型素材における供給穴形成前の状態である無穴金型素材の上面に予め接合しておき，上記供給穴は，上記無穴金型素材と上記接合媒体とに同時に形成することを特徴とするハニカム構造体成形用金型の製造方法。

【請求項９】　請求項６において，上記第１金型素材と上記有穴金型素材とを接合する上記接合媒体は，上記有穴金型素材に形成された供給穴と連通する位置に，予めドリル加工，放電加工，プレス加工の少なくとも１手段によって連通穴を形成しておくことを特徴とするハニカム構造体成形用金型の製造方法。

【請求項１０】　請求項６～９のいずれか一項において，上記接合媒体は，金属箔を熱拡散又はろう付けにより金型素材に接合して形成し，或いは，メッキ又は蒸着により上記金型素材に形成してなり，かつ，上記接合媒体の厚みは０．００５～１ｍｍであることを特徴とするハニカム構造体成形用金型の製造方法。

【請求項１１】　請求項１～１０のいずれか一項において，上記第１金型素材，第２金型素材，及び有穴金型素材は，超硬合金からなることを特徴とするハニカム構造体成形用金型の製造方法。

【請求項１２】　請求項１１において，上記超硬合金は，周期律表第４ａ，５ａ，６ａ族に属する金属の少なくとも一種以上の金属の炭化物からなる炭化物粉末に対して，鉄，コバルト，ニッケルの少なくとも一種以上の金属を３～３０％添加し，焼結合金としたものであることを特徴とするハニカム構造体成形用金型の製造方法。

【請求項１３】　ハニカム状の貫通したスリット溝を形成した第１金型素材と，材料を供給するための供給穴を有する有穴金型素材とが接合してなると共に，上記スリット溝と上記供給穴とが連通してなることを特徴とするハニカム構造体成形用金型。

【請求項１４】　請求項１３において，上記第１金型素材，第２金型素材，及び有穴金型素材は，超硬合金からなることを特徴とするハニカム構造体成形用金型。

【請求項１５】　請求項１４において，上記超硬合金は，周期律表第４ａ，５ａ，６ａ族に属する金属の少なくとも一種以上の金属の炭化物からなる炭化物粉末に対して，鉄，コバルト，ニッケルの少なくとも一種以上の金属を３～３０％添加し，焼結合金としたものであることを特徴とするハニカム構造体成形用金型。

【請求項１６】　請求項１３～１５のいずれか一項において，上記第１金型素材と上記第２金型素材との間，及

び上記第１金型素材と上記有穴金型素材との間には，接合媒体を介在させてあることを特徴とするハニカム構造体成形用金型。

【請求項１７】　請求項１６において，上記接合媒体は，金属箔を熱拡散又はろう付けにより金型素材に接合して形成し，或いは，メッキ又は蒸着により上記金型素材に形成してなり，かつ，上記接合媒体の厚みは０．００５～１ｍｍであることを特徴とするハニカム構造体成形用金型。

【発明の詳細な説明】

【０００１】

【技術分野】本発明は，ハニカム構造成形体を成形するための金型をワイヤ放電加工を用いて製造するハニカム構造体成形用金型及びその製造方法に関する。

【０００２】

【従来技術】例えばコージェライト等を主成分としたセラミック製のハニカム構造体は，成形用金型を用いて材料を押出成形することにより製造される。このハニカム構造体は，隔壁を格子状に設けて多数のセルを構成してなり，そのセル形状としては，四角形，六角形等種々の形状がある。

【０００３】例えば六角形状のセルを有するハニカム構造体を製造するには，六角形格子状のスリット溝を有する金型を用いる。具体的には，図２に示すような，材料供給用の供給穴１３１と，該供給穴１３１に連通して六角格子状に設けたスリット溝１５とを有するハニカム構造体成形用金型を用いる。

【０００４】上記のごときハニカム構造体成形用金型を製造する方法としては，従来，特開平２－５２７０３号公報に開示されるワイヤ放電加工を用いた製造方法がある。上記従来のハニカム構造体成形用金型９の製造方法を，図１６，図１７を用いて説明する。なお，図１６において，（Ａ－１）～（Ｄ－１）は，１次加工体～３次加工体及びハニカム構造体成形用金型９の上面を上にした斜視図で，（Ａ－２）～（Ｄ－２）は，下面を上にした斜視図である。

【０００５】まず，第１金型素材９１に互いに独立した多数条の貫通した１次溝９１５を，ワイヤ放電加工により形成して，１次加工体９０１を得る（図１６（Ａ－１），（Ａ－２））。次いで，第２金型素材９２を上記１次加工体９０１の上面に接合して２次加工体９０２を得る（図１６（Ｂ－１），（Ｂ－２））。

【０００６】次いで，上記２次加工体９０２に，互いに独立した多数条の貫通した２次溝９２５を，ワイヤ放電加工により形成することにより，３次加工体９０３を得る（図１６（Ｃ－１））。この際，上記第１金型素材９１には上記２次溝９２５が１次溝９１５と連通することにより上記ハニカム状のスリット溝９５を形成する（図１６（Ｃ－２））。

【０００７】次いで，上記供給穴９３１を有する有穴金型素材９３を上記第２金型素材９２の下面に接合することにより，上記ハニカム構造体成形用金型９を得る（図１６（Ｄ－１），（Ｄ－２））。このとき，上記供給穴９３１は，図１７（Ｂ）に示すごとく，上記スリット溝９５の交点の位置に配置されるように接合する。

【０００８】このようにして，ワイヤ放電加工を用いてハニカム構造体成形用金型９を製造する。上記製造方法においてはワイヤ放電加工を用いるため，任意のハニカム形状のスリット溝を容易かつ生産効率良くハニカム構造体成形用金型を製造することができる。

【０００９】

【解決しようとする課題】しかしながら，上記従来のハニカム構造体成形用金型９の製造方法には以下の問題点がある。即ち，上記ハニカム構造体成形用金型９は，第１金型素材９１と有穴金型素材９３との間に第２金型素材９２を介在させて三層構造としているため，上記第１金型素材９１に形成されたスリット溝９５は，直接上記供給穴９３１に連結されていない（図１７（Ａ））。

【００１０】つまり，図１７（Ｄ）に示すごとく，上記第１金型素材９１には，六角形のハニカム状のスリット溝９５が設けられている。即ち，上記六角形の一単位は図１８（Ａ）における符号Ｍ，Ｎ，Ｏ，Ｐ，Ｑ，Ｒに示す６辺のスリット溝により形成されている。

【００１１】一方，上記第２金型素材９２には，図１７（Ｃ），図１６（Ｃ－１）に示すごとく，上記２次溝９２５がジグザグ形状に形成されているのみである。即ち，図１８（Ｂ）に示すごとく，上記第２金型素材９２には，上記スリット溝Ｍ，Ｎ，Ｏ，Ｐ，Ｑ，Ｒによる六角形に対応する部分に関しては，４辺の２次溝Ｓ，Ｔ，Ｕ，Ｖが形成されているのみである。

【００１２】そのため，上記供給穴９３１に供給した材料は上記２次溝Ｓ，Ｔ，Ｕ，Ｖに供給され，これが直接上記スリット溝Ｍ，Ｎ，Ｏ，Ｑに供給されるが，上記スリット溝Ｐ，Ｒには直接供給されない。その結果，材料は上記スリット溝Ｐ，Ｒに充分に供給されず，上記ハニカム構造体成形用金型９から押出されるハニカム構造体に歪み等の不具合が生ずるおそれがある。

【００１３】また，上記２次溝９２５に供給された材料は，ここである程度成形され流動性を損なうために，上記スリット溝９５の全域に均一に供給することが困難となる。そのため，得られるハニカム構造体に歪み等の不具合が生じるおそれがある。

【００１４】本発明は，かかる従来の問題点に鑑みてなされたもので，歪み等の不具合が発生しないハニカム構造体を成形することができるハニカム構造体成形用金型を，ワイヤ放電加工を用いて製造することができるハニカム構造体成形用金型及びその製造方法を提供しようとするものである。

【００１５】

【課題の解決手段】請求項１に記載の発明は，材料を供

給するための供給穴と，該供給穴に連通し材料をハニカム形状に成形するためのスリット溝とを有するハニカム構造体成形用金型を製造する方法において，該製造方法は，第１金型素材に互いに独立した多数条の貫通した１次溝を，ワイヤ放電加工により形成して，１次加工体を得る第１工程と，第２金型素材を上記１次加工体の上面に接合して２次加工体を得る第２工程と，上記２次加工体に，互いに独立した多数条の貫通した２次溝を，ワイヤ放電加工により形成し，この際上記第１金型素材には上記２次溝が上記１次溝と連通することにより形成される上記ハニカム状のスリット溝を形成することにより，３次加工体を得る第３工程と，上記供給穴を有する有穴金型素材を上記第１金型素材の下面に接合して４次加工体を得る第４工程と，上記４次加工体から上記第２金型素材を除去する第５工程とからなることを特徴とするハニカム構造体成形用金型の製造方法にある。

【００１６】本発明において最も注目すべきことは，上記第４工程において有穴金型素材を上記第１金型素材の下面に接合し，上記第５工程において，上記４次加工体から第２金型素材を除去することである。即ち，上記ハニカム状のスリット溝が形成された上記第１金型素材の下面に，直接上記有穴金型素材を接合する（図１（Ｄ－１），（Ｄ－２）参照）。その後，上記第１金型素材の上面に接合された第２金型素材を除去する（図１（Ｅ－１），（Ｅ－２）参照）。

【００１７】次に，本発明の作用効果につき説明する。上記ハニカム構造体成形用金型の製造方法においては，上記のごとく，上記ハニカム状のスリット溝が形成された上記第１金型素材の下面に，直接上記有穴金型素材を接合した後，上記第１金型素材の上面に接合された第２金型素材を除去する。

【００１８】そのため，上記製造方法により得られるハニカム構造体成形用金型の上記スリット溝は直接上記供給穴に連結される。それ故，ハニカム構造体の成形に当り，上記供給穴に供給した材料が上記スリット溝に直接供給される。即ち，上記供給穴に供給した材料が，流動性のあるままの状態で直接上記スリット溝に供給される。それ故，材料は，上記スリット溝の全域に均一に供給され，成形されるハニカム構造体が歪む等の不具合が生ずるおそれがない。

【００１９】以上のごとく，本発明によれば，歪み等の不具合が発生しないハニカム構造体を成形することができるハニカム構造体成形用金型を，ワイヤ放電加工を用いて製造することができるハニカム構造体成形用金型の製造方法を提供することができる。

【００２０】次に，請求項２に記載の発明のように，材料を供給するための供給穴と，該供給穴に連通し材料をハニカム形状に成形するためのスリット溝とを有するハニカム構造体成形用金型を製造する方法において，該製造方法は，第１金型素材に一筆書き的に連結した多数条の貫通した１次溝を，ワイヤ放電加工により形成して，１次加工体を得る第１工程と，第２金型素材を上記１次加工体の上面に接合して２次加工体を得る第２工程と，上記２次加工体に，一筆書き的に連結した多数条の貫通した２次溝を，ワイヤ放電加工により形成し，この際上記第１金型素材には上記２次溝が上記１次溝と連通することにより形成される上記ハニカム状のスリット溝を形成することにより，３次加工体を得る第３工程と，上記供給穴を有する有穴金型素材を上記第１金型素材の下面に接合して４次加工体を得る第４工程と，上記４次加工体から上記第２金型素材を除去する第５工程とからなることを特徴とするハニカム構造体成形用金型の製造方法がある。

【００２１】即ち，上記第１工程及び第３工程において，請求項１の発明とは異なり，上記多数条の１次溝及び２次溝を互いに独立させることなく，一筆書き的に連結させて形成する（図５（Ａ－１），（Ｃ－１）参照）。そのため，ワイヤ放電加工する際のスタートポイントとして使用する小径の貫通穴を多数設ける必要がない。また，１次溝或いは２次溝を１条加工する毎に段取り作業をする必要もない。従って，一層生産効率良くハニカム構造体成形用金型を製造することができる。

【００２２】次に，請求項３に記載の発明のように，上記第５工程は，第２金型素材を平面研削によって除去することもできる。これにより，上記第２金型素材を容易に除去することができる。また，この場合には，特に加工時間が短く，仕上り面が平滑となるという利点がある。

【００２３】次に，請求項４に記載の発明のように，上記第５工程は，第２金型素材をワイヤーカットによって除去することもできる。この場合にも，上記第２金型素材を容易に除去することができる。また，この場合には，特にバリが発生しないという利点がある。

【００２４】次に，請求項５に記載の発明のように，上記スリット溝は，四角形，六角形，又は円形のいずれかとすることもできる。即ち，上記スリット溝により形成されるハニカムの一つの格子が四角形，六角形，円形とすることができる。

【００２５】これにより，四角形等の任意のスリット溝を有し，それぞれの形状のハニカム構造体を成形するための，ハニカム構造体成形用金型を得ることができる。なお，上記ハニカム構造体成形用金型の製造方法は，ワイヤ放電加工により，上記スリット溝を形成するため，上記いずれの形状のスリット溝であっても，容易に加工することができる。

【００２６】次に，請求項６に記載の発明のように，上記第１金型素材と上記第２金型素材との接合，及び上記第１金型素材と上記有穴金型素材との接合は，接合面に接合媒体を介在させることにより行うことが好ましい。これにより，上記第１金型素材と上記第２金型素材との

接合，及び上記第１金型素材と上記有穴金型素材との接合を容易かつ確実に行うことができる。

【００２７】次に，請求項７に記載の発明のように，上記接合媒体は，上記第１金型素材の両面に予め接合しておき，上記１次溝は，上記第１金型素材と上記接合媒体とに同時に形成し，また，上記２次溝は，上記第１金型素材と上記第２金型素材と上記接合媒体とに同時に形成することが好ましい。この場合には，上記第１金型素材に形成されたスリット溝と，上記有穴金型素材の供給穴との間に，上記接合媒体が残留することがない。そのため，この接合媒体を，上記第１金型素材と有穴金型素材との接合後に，選択的に除去する必要もない。それ故，一層容易にハニカム構造体成型用金型を製造することができる。

【００２８】なお，上記接合媒体は，上記第１金型素材の下面にのみ予め接合しておき，上記２次溝を，上記第１金型素材と上記第２金型素材と上記接合媒体とに同時に形成することもできる。この場合にも，上記と同様，容易にハニカム構造体成型用金型を製造することができる。

【００２９】次に，請求項８に記載の発明のように，上記第１金型素材と上記有穴金型素材とを接合する上記接合媒体は，上記有穴金型素材における供給穴形成前の状態である無穴金型素材の上面に予め接合しておき，上記供給穴は，上記無穴金型素材と上記接合媒体とに同時に形成することが好ましい。この場合にも，上記第１金型素材に形成されたスリット溝と，上記有穴金型素材の供給穴との間に，上記接合媒体が残留することがない。そのため，この接合媒体を，上記第１金型素材と有穴金型素材との接合後に，選択的に除去する必要もない。それ故，一層容易にハニカム構造体成型用金型を製造することができる。

【００３０】次に，請求項９に記載の発明のように，上記第１金型素材と上記有穴金型素材とを接合する上記接合媒体は，上記有穴金型素材に形成された供給穴と連通する位置に，予めドリル加工，放電加工，プレス加工の少なくとも１手段によって連通穴を形成しておくことが好ましい。これにより，上記接合媒体の連通穴の形成時に，その切削屑が有穴金型素材に残留するおそれがない。

【００３１】次に，請求項１０に記載の発明のように，上記接合媒体は，金属箔を熱拡散又はろう付けにより金型素材に接合して形成し，或いは，メッキ又は蒸着により上記金型素材に形成してなり，かつ，上記接合媒体の厚みは０．００５～１ｍｍであることが好ましい。ここで，上記金型素材とは，上記第１金型素材，第２金型素材，有穴金型素材，又は無穴金型素材を意味する。即ち，上記接合媒体は，金属箔を上記第１金型素材，有穴金型素材等の上面或いは下面に配置し，熱拡散又はろう付けにより接合することにより形成する。或いは，メッキ，又はＰＶＤ，ＣＶＤ等の蒸着により上記第１金型素材，有穴金型素材等の上面或いは下面に金属を成膜することにより上記接合媒体を形成する。

【００３２】これにより，上記第１金型素材と上記第２金型素材との接合，或いは上記第１金型素材と上記有穴金型素材との接合を，一層容易かつ確実に行うことができる。上記金属箔は，本発明に使用する超硬合金中に含まれる金属粉末との拡散性に影響し，それに支配される接合性，接合強度の観点から，金，銀，銅，ニッケル等を主成分とする金属若しくは合金であることが好ましい。

【００３３】また，上記接合媒体の厚みを，０．００５～１ｍｍとすることにより，一層高い接合強度を得ることができる。即ち，接合媒体の部分からの破断や，接合媒体の部分の選択的磨耗を防止し，耐久性に優れたハニカム構造体成形用金型を得ることができる。

【００３４】上記接合媒体の厚みが０．００５ｍｍ未満の場合には，接合しようとする相対する金型素材同志の接合界面の平面度を０．００５ｍｍ未満とする必要がある。これにより，後に詳述する本発明で製作する大きさのハニカム構造体成形用金型を製作した場合，その面積ゆえに著しく時間と手間がかかり経済性に劣る。また，上記平面度を０．００５ｍｍ未満に仕上げられなかった場合，接合界面同志の密着が妨げられ，金型素材の接合が困難となり，充分な接合強度を得ることができないおそれがある。一方，上記厚みが１ｍｍを超える場合には，接合媒体の部分への応力集中による破断や，ハニカム構造体を成す材料を押出し成形した場合，接合媒体の部分が選択的に磨耗し，最悪の場合には接合媒体の部分から破断を生ずるおそれがある。

【００３５】次に，請求項１１に記載の発明のように，上記第１金型素材，第２金型素材，及び有穴金型素材は，超硬合金からなることが好ましい。これにより，各金型素材の接合において，寸法精度の維持を容易かつ確実に行うことができる。上記超硬合金とは，金属炭化物粉末と金属粉末を配合して焼結した硬い焼結合金をいう。上記超硬合金としては，例えば，炭化タングステン（ＷＣ）を主成分としコバルト（Ｃｏ）で固めてなる焼結金属がある。

【００３６】次に，請求項１２に記載の発明のように，上記超硬合金は，周期律表第４ａ，５ａ，６ａ族に属する金属の少なくとも一種以上の金属の炭化物からなる炭化物粉末に対して，鉄，コバルト，ニッケルの少なくとも一種以上の金属を３～３０％添加し，焼結合金としたものであることが好ましい。即ち，Ｔｉ，Ｖ，Ｃｒ，Ｚｒ，Ｎｂ，Ｍｏ，Ｈｆ，Ｔａ，Ｗのうち少なくとも一種以上の金属の炭化物からなる炭化物粉末に対し，含有量が３～３０％となるよう鉄，コバルト，ニッケルの少なくとも一種以上を添加して，焼結することにより上記超硬合金を得る。

【００３７】これにより，上記スリット溝の加工や各金型素材の接合を一層容易かつ確実に行うことができる。また，上記鉄，コバルト，ニッケルの各金属を単独で添加する場合にはその含有量が３～３０％であり，複数種類の金属を添加する場合には，その合計の含有量が３～３０％である。

【００３８】金型素材を接合処理する際の高温度域での素材耐力に直接影響し，接合前に既に形成されている上記１次溝等の寸法精度の維持に大きく影響する。また，接合媒体との拡散性にも影響し，接合性，接合強度にも影響する。即ち，上記含有量が３０％を超える場合には，後に詳述するような接合に用いる高温域での素材耐力が低く，接合時の素材自重や後に詳述する密着性を高めるための加圧により上記１次溝等の寸法が変化し，型として成立しないおそれがある。一方，上記含有量が３％未満の場合には，接合媒体と各金型素材との拡散性が低下し，接合性，接合強度が低下するおそれがある。また，この場合には靭性が低くなり，金型として使用する際に破損し易く，亀裂伝播性も上がるため，極めて取り扱いに注意を要する。

【００３９】次に，請求項１３に記載の発明のように，ハニカム状の貫通したスリット溝を形成した第１金型素材と，材料を供給するための供給穴を有する有穴金型素材とが接合してなると共に，上記スリット溝と上記供給穴とが連通してなることを特徴とするハニカム構造体成形用金型がある。

【００４０】上記ハニカム構造体成形用金型においては，上記スリット溝は，直接上記供給穴に連通している。それ故，上記ハニカム構造体成形用金型を用いてハニカム構造体を成形するに当り，上記供給穴に供給した材料が上記スリット溝に直接供給される。即ち，上記供給穴に供給した材料が，流動性のあるままの状態で直接上記スリット溝に供給される。そのため，材料は上記スリット溝の全域に均一に供給され，成形されるハニカム構造体が歪む等の不具合が生ずるおそれがない。

【００４１】次に，請求項１４に記載の発明のように，上記第１金型素材，第２金型素材，及び有穴金型素材は，超硬合金からなることが好ましい。これにより，各金型素材の接合において寸法精度の維持を容易かつ確実に行うことができる。

【００４２】次に，請求項１５に記載の発明のように，上記超硬合金は，周期律表第４ａ，５ａ，６ａ族に属する金属の少なくとも一種以上の金属の炭化物からなる炭化物粉末に対して，鉄，コバルト，ニッケルの少なくとも一種以上の金属を３～３０％添加し，焼結合金としたものであることが好ましい。これにより，上記スリット溝が一層確実に形成され，各金型素材が一層確実に接合されたハニカム構造体成型用金型を得ることができる。

【００４３】次に，請求項１６に記載の発明のように，上記第１金型素材と上記第２金型素材との間，及び上記第１金型素材と上記有穴金型素材との間には，接合媒体を介在させてあることが好ましい。これにより，各金型素材が一層確実に接合されたハニカム構造体成型用金型を得ることができる。

【００４４】次に，請求項１７に記載の発明のように，上記接合媒体は，金属箔を熱拡散又はろう付けにより金型素材に接合して形成し，或いは，メッキ又は蒸着により上記金型素材に形成してなり，かつ，上記接合媒体の厚みは０．００５～１ｍｍであることが好ましい。ここで，上記金型素材とは，上記第１金型素材，第２金型素材，有穴金型素材，又は無穴金型素材を意味する。これにより，上記第１金型素材と上記第２金型素材との接合，或いは上記第１金型素材と上記有穴金型素材との接合を，一層容易かつ確実に行うことができる。上記金属箔は，接合性，接合強度の観点から，金，銀，銅，ニッケル等を主成分とする金属若しくは合金であることが好ましい。上記接合媒体の厚みの臨界意義は，上記請求項１０の発明の場合と同様である。

【００４５】

【発明の実施の形態】実施形態例１

本発明の実施形態例にかかるハニカム構造体成形用金型の製造方法につき，図１～図３を用いて説明する。本例において製造するハニカム構造体成形用金型１は，図２に示すごとく，材料を供給するための供給穴１３１と，該供給穴１３１に連通し材料をハニカム形状に成形するためのスリット溝１５とを有する。

【００４６】上記製造方法は，図１に示すごとく，第１工程～第５工程よりなる。図１において，（Ａ－１）～（Ｅ－１）は，第１加工体～第４加工体及びハニカム構造体成形用金型の上面を上にした斜視図で，（Ａ－２）～（Ｅ－２）は，下面を上にした斜視図である。

【００４７】即ち，第１工程においては，第１金型素材１１に互いに独立した多数条の貫通した１次溝１１５を，ワイヤ放電加工により形成して，１次加工体１０１を得る（図１（Ａ－１），（Ａ－２））。次いで，第２工程において，第２金型素材１２を上記１次加工体１０１の上面に接合して２次加工体１０２を得る（図１（Ｂ－１），（Ｂ－２））。

【００４８】次いで，第３工程において，上記２次加工体１０２に，互いに独立した多数条の貫通した２次溝１２５を，ワイヤ放電加工により形成して，３次加工体１０３を得る（図１（Ｃ－１））。この際上記第１金型素材１１には，上記２次溝１２５が上記１次溝１１５と連通することにより形成される上記ハニカム状のスリット溝１５を形成する（図１（Ｃ－２），図３（Ｃ））。

【００４９】次いで，第４工程において，上記供給穴１３１を有する有穴金型素材１３を上記第１金型素材１１の下面に接合して４次加工体１０４を得る（図１（Ｄ－１），（Ｄ－２））。次いで，第５工程において，上記４次加工体１０４から第２金型素材１２を除去すること

によりハニカム構造体成形用金型１を得る（図１（Ｅ－１），（Ｅ－２））。

【００５０】なお，上記第１工程と第３工程において，１次溝１１５及び２次溝１２５を形成するに当っては，第１金型素材１１或いは２次加工体１０２に小径の貫通穴を設け，該貫通穴にワイヤー電極を通す。そして，該ワイヤー電極を相対的に移動させながら放電加工する。第１金型素材１１等が，上記１次溝１１５等の形成により分離しないよう，端部だけは加工せずに残しておくためである。

【００５１】また，上記第２工程と第４工程において，第１金型素材１１と第２金型素材１２，或いは，第１金型素材１１と有穴金型素材１３は，拡散溶接法により接合する。また，上記第５工程において，第２金型素材１２の除去は，平面研削盤を用いて平面研削することにより行う。

【００５２】次に，本例の作用効果につき説明する。上記ハニカム構造体成形用金型１の製造方法においては，上記のごとく，上記ハニカム状のスリット溝１５が形成された上記第１金型素材１１の下面に，直接上記有穴金型素材１３を接合した後，上記第１金型素材１１の上面に接合された第２金型素材１２を除去する（図１（Ｄ－１），（Ｄ－２），（Ｅ－１），（Ｅ－２））。

【００５３】そのため，上記製造方法により得られるハニカム構造体成形用金型１の上記スリット溝１５は，図３（Ａ））に示すごとく，直接上記供給穴１３１に連結される。それ故，ハニカム構造体の成形に当り，図３（Ｂ）に実線で示す上記供給穴１３１に供給した材料が，図３（Ｃ）に実線で示す上記スリット溝１５に直接供給される。即ち，上記供給穴に供給した材料が，流動性のあるままの状態で直接上記スリット溝に供給される。これにより，材料は，上記スリット溝１５の全域に均一に供給される。そのため，成形されるハニカム構造体が歪む等の不具合が生ずるおそれがない。

【００５４】なお，図３（Ｄ）は，図１（Ｄ－２）のＤ－Ｄ線矢視断面図であり，ハニカム構造体成形用金型１の製造途中のものであるため，完成したハニカム構造体成形用金型１には，同図に示す断面は存在しない。また，上記第５工程は，第２金型素材１０２を平面研削によって除去するため，上記第２金型素材１０２を容易に除去することができる。

【００５５】以上のごとく，本例によれば，歪み等の不具合が発生しないハニカム構造体を成形することができるハニカム構造体成形用金型を，ワイヤ放電加工を用いて製造することができる。

【００５６】実施形態例２

本例は，図４に示すごとく，実施形態例１のハニカム構造体成形用金型及びその製造方法のより具体的な例を示す。本例のハニカム構造体成形用金型１は，図４（Ａ）に示すごとく，方形板状体の有穴金型素材１３と，円形板状体の第１金型素材１１とよりなる。上記有穴金型素材１３と第１金型素材１１，及び後述の第２金型素材は，金型用鉄鋼材料からなる。

【００５７】また，上記有穴金型素材１３の外形は成形機への取付寸法を基に決定され，本例の有穴金型素材１３は２００ｍｍ四方である。一方，上記第１金型素材１１は，直径１３０ｍｍ程度である。また，上記ハニカム構造体成形用金型１の厚みは，２０ｍｍ程度である。

【００５８】上記第１金型素材１１には，図４（Ｃ）に示すごとく，多数の六角形のハニカム形状のスリット溝１５が形成されている。該スリット溝１５の溝幅は，０．１ｍｍである。一方，上記有穴金型１３には，上記スリット溝１５の交点に対応して，直径１．０ｍｍの材料供給用の供給穴１３１が多数設けられている（図４（Ｃ）の破線）。該供給穴１３１は，上記スリット溝１５に連通しており，上記供給穴１３１から供給した材料は，上記スリット溝１５に供給される。なお，図４（Ａ）において，符号１３９は，上記ハニカム構造体成形用金型１を成形機に取付けるための取付穴である。

【００５９】上記ハニカム構造体成形用金型１の製造方法は，上記実施形態例１で示した製造方法と，基本的には同様である。本例の場合は，実施形態例１に示した第１工程においては，直径０．０７ｍｍのタングステンワイヤ電極を用いたワイヤ放電加工により，上記六角形のハニカムの略半分の形状の一次溝を，円形板状体の上記第１金型素材１１に形成する。また，第２工程においては，拡散溶接法を用いて，上記１次加工体に第２金型素材を接合する。また，第３工程においては，上記と同様のワイヤ放電加工により２次溝を形成する。

【００６０】第４工程においては，上記第１金型素材１１の下面に，予め供給穴１３１を設けた方形板状体の有穴金型素材１３を拡散溶接法により接合して４次加工体を得る。次いで，第５工程において，上記４次加工体の第２金型素材を平面研削盤により平面研削して除去する。これにより，図４（Ａ），（Ｂ）に示すハニカム構造体成形用金型１を得る。その他は，実施形態例１と同様である。本例の場合にも，実施形態例１と同様の作用効果を有する。

【００６１】なお，本例においては，直径０．０７ｍｍのワイヤ電極を用いて，溝幅０．１ｍｍのスリット溝を形成するものであったが，上記ワイヤ電極の直径を更に小さくして，例えば０．０７５ｍｍ，０．０５ｍｍという更に細いスリット溝を形成することもできる。また，上記有穴金型素材，第１金型素材，及び第２金型素材として，金型用鉄鋼材料を使用したが，焼結金属等の他の材料を使用してもよい。

【００６２】また，上記実施形態例１，実施形態例２の第２工程及び第４工程において，第１金型素材と第２金型素材，或いは第１金型素材と有穴金型素材の接合には，拡散溶接法を用いたが，例えばろう付け法，接着法

等の他の接合方法を用いることもできる。

【００６３】実施形態例３

本例は，図５に示すごとく，第１工程及び第３工程において，多数条の１次溝１１５及び２次溝１２５を互いに独立させることなく，一筆書き的に連結させて形成する例である。即ち，上記実施形態例１の１次溝及び２次溝が，互いに独立している（図１（Ａ－１），（Ｃ－１））のに対し，本例の１次溝１１５及び２次溝１２５は，図５（Ａ－１），（Ｃ－１）に示すごとく，連結溝１１６，１２６によって連結されている。

【００６４】本例のハニカム構造体成形用金型１の製造方法は，第１工程において，図５（Ａ－１），（Ａ－２）に示すごとく，第１金型素材１１に一筆書き的に連結した多数条の貫通した１次溝１１５を，ワイヤ放電加工により形成する。

【００６５】また，第３工程においては，２次加工体１０２（図５（Ｂ－１），（Ｂ－２））に，一筆書き的に連結した多数条の貫通した２次溝１２５を，ワイヤ放電加工により形成する（図５（Ｃ－１））。この際上記第１金型素材１１には，上記２次溝１２５が上記１次溝１１５と連通することにより形成される上記ハニカム状のスリット溝１５を形成することにより，３次加工体１０３を得る（図５（Ｃ－２））。

【００６６】なお，上記第１工程と第３工程以外の，第２工程，第４工程，及び第５工程については，実施形態例１と同様である。また，図５（Ｄ－１），（Ｄ－２）は，第４工程によって得られる４次加工体１０４を表し，図５（Ｅ－１），（Ｅ－２）は，最終的に得られるハニカム構造体成形用金型１を表す。

【００６７】本例のハニカム構造体成形用金型１の製造方法は，第１工程，第３工程において，第１金型素材１１或いは第２金型素材１０２に一筆書き的に連結した多数条の貫通した１次溝１１５或いは，２次溝１２５を形成する（図５（Ａ－１），（Ａ－２），（Ｃ－１））。

【００６８】そのため，ワイヤ放電加工する際のスタートポイントとして使用する小径の貫通穴を多数設ける必要がない。即ち，第１金型素材１１に１箇所，２次加工体１０２に１箇所それぞれ設ければ足りる。また，１次溝１１５或いは２次溝１２５を１条加工する毎に段取り作業をする必要もない。従って，一層生産効率良くハニカム構造体成形用金型を製造することができる。その他，実施形態例１と同様の作用効果を有する。

【００６９】なお，上記実施形態例１～３の第５工程において，第２金型素材の除去は，表面研削盤を用いた表面研削により行ったが，ワイヤ放電加工等の他の方法によっても除去することができる。更には，上記スリット溝のハニカムの形状は六角形に限らず，四角形，円形等，他の形状とすることもできる。

【００７０】実施形態例４

本例は，図６～図８に示すごとく，第１金型素材１１と第２金型素材１２との接合，及び第１金型素材１１と有穴金型素材１３との接合を，接合面に接合媒体２１又は２２を介在させることにより行う例である。図６～図８において，（Ａ－１）～（Ｆ－１）は上面図，（Ａ－２）～（Ｆ－２）は下面図，（Ａ－３）～（Ｆ－３）は，（Ａ－１）～（Ｆ－１）或いは（Ａ－２）～（Ｆ－２）のＪ－Ｊ線矢視断面相当の説明図である。

【００７１】本例のハニカム構造体成型用金型の製造方法につき，図６～図８を用いて説明する。まず，第１工程において，図６（Ａ－１），（Ａ－２），（Ａ－３）に示すごとく，第１金型素材１１に１次溝１１５を形成して，１次加工体１０１を得る。上記第１金型素材１１は，超硬合金からなる。該超硬合金は，炭化タングステン（ＷＣ）を主成分としコバルトで固めてなる焼結金属であり，コバルト含有量は約１２％である。また，第２金型素材１２，及び有穴金型素材１３も，同様の超硬合金からなる。

【００７２】次いで，第２工程において，図６（Ｂ－１），（Ｂ－２），（Ｂ－３）に示すごとく，上記第１金型素材１１の上面にニッケル（Ｎｉ）箔からなる接合媒体２１を介在させて，上記第２金型素材１２を接合する。接合に当っては，密着性を向上させるため，各金型素材及び接合媒体２１の平面度を約０．２ｍｍ以下に仕上げておく。そして，上記第１金型素材１１と第２金型素材１２との接合面に上記接合媒体２１を介在させ，該接合媒体２１のクリープ温度，即ち固有である溶融温度の１／２程度以上かつ溶融温度未満で加熱する。また，接合界面に酸化物を生成させず，また付着した酸化物を固有の蒸気圧で蒸発させるため，真空雰囲気中で加熱する。また，接合界面の密着性を向上させるため，昇温時または降温時に加圧する。ただし，金型素材の高温耐力に影響される寸法精度の維持の観点から，最大でも１００ＭＰａ以下の加圧とする。

【００７３】これにより，２次加工体１０２を得る。また，接合強度の観点から，上記接合媒体２１の厚みは約５０μｍとしている。また，上記接合媒体２１は，上記のごとく高温条件下で焼きなまされるため，その硬さについては特に問題とはならない。例えば，上記接合媒体２１の硬さとしては，１／４Ｈ～Ｈ材のものであれば充分である。

【００７４】次いで，第３工程において，図７（Ｃ－１），（Ｃ－２），（Ｃ－３）に示すごとく，上記２次加工体１０２に２次溝１２５を形成して，３次加工体１０３を得る。このとき，上記第１金型素材１１には，ハニカム状のスリット溝１５が形成されている（図７（Ｃ－２））。

【００７５】次いで，第４工程において，図７（Ｄ－１），（Ｄ－２），（Ｄ－３）に示すごとく，上記第１金型素材１１の下面に接合媒体２２を介在させて，上記有穴金型素材１３を接合する。この接合媒体２２及び接

合方法は，第２工程において用いた接合媒体２１及び接合方法と同様である。これにより，４次加工体１０４を得る。このとき，上記スリット溝１５は第１金型素材１１の下面から上記接合媒体２２によって閉塞され，上記供給穴１３１も上記有穴金型素材１３の上面から上記接合媒体２２によって閉塞されている（図７（Ｄ－３））。従って，上記供給穴１３１とスリット溝１５とは，連通していない状態にある。

【００７６】次いで，第５工程において，図８（Ｅ－１），（Ｅ－２），（Ｅ－３）に示すごとく，上記４次加工体１０４から第２金型素材１２及びその下面の接合媒体２１を除去する。次いで，上記供給穴１３１とスリット溝１５との連通を阻害している接合媒体２２を，例えば流体研磨によって選択的に除去する。これにより，図８（Ｆ－１），（Ｆ－２），（Ｆ－３）に示すごとく，上記供給穴１３１とスリット溝１５とが連通し，ハニカム構造体成型用金型１が完成する。その他は，実施形態例１と同様である。

【００７７】本例の場合には，上記接合媒体２１，２２を用いるため，第１金型素材１１と第２金型素材１２との接合，及び第１金型素材１１と有穴金型素材１３との接合を容易かつ確実に行うことができる。また，上記接合媒体２１，２２はニッケル箔からなるため，第１金型素材１１と第２金型素材１２との接合，及び第１金型素材１１と有穴金型素材１３との接合を，一層容易かつ確実に行うことができる。また，上記接合媒体２１，２２の厚みを約５０μｍとしているため，より高い接合強度を得ることができる。

【００７８】また，上記第１金型素材１１，第２金型素材１２，及び有穴金型素材１３は，コバルト含有量が約１２％の超硬合金からなるため，接合に用いる高温域での素材耐力も充分確保されており，各金型素材の接合において寸法精度の維持を容易かつ確実に行うことができる。また，靭性も適度に有するため，金型として使用する際に破損し難く，ハニカム構造体成形用金型の取り扱いに特別な注意を要しない。その他，実施形態例１と同様の作用効果を有する。

【００７９】実施形態例５

本例は，図９～図１１に示すごとく，第１金型素材１１の両面に，予め接合媒体２１，２２を接合しておく例である。そして，１次溝１１５を，上記第１金型素材１１と上記接合媒体２１，２２とに同時に形成し（図９（Ｂ－３）），また，２次溝１２５を，２次加工体１０２と上記接合媒体２１，２２とに同時に形成する（図１０（Ｄ－３））。図９～図１１において，（Ａ－１）～（Ｆ－１）は上面図，（Ａ－２）～（Ｆ－２）は下面図，（Ａ－３）～（Ｆ－３）は，（Ａ－１）～（Ｆ－１）或いは（Ａ－２）～（Ｆ－２）のＫ－Ｋ線矢視断面相当の説明図である。

【００８０】本例のハニカム構造体成型用金型の製造方法につき，図９～図１１を用いて説明する。まず，第１工程において，図９（Ａ－１），（Ａ－２），（Ａ－３）に示すごとく，第１金型素材１１の両面に接合媒体２１，２２を接合しておき，図９（Ｂ－１），（Ｂ－２），（Ｂ－３）に示すごとく，１次溝１１５を形成する。このとき，該１次溝１１５は，上記金型素材１１と，その両面に接合された接合媒体２１，２２とに同時に形成される。これにより，１次加工体１０１を得る。上記第１金型素材１１，第２金型素材１２，及び有穴金型素材１３の材質，更には，接合媒体２１，２２の材質及び厚みは，上記実施形態例４の場合と同様である。

【００８１】次いで，第２工程において，図１０（Ｃ－１），（Ｃ－２），（Ｃ－３）に示すごとく，上記第１金型素材１１の上面に，上記接合媒体２１を介して上記第２金型素材１２を接合する。このときの接合方法は，実施形態例４の場合と同様である。これにより，２次加工体１０２を得る。

【００８２】次いで，第３工程において，図１０（Ｄ－１），（Ｄ－２），（Ｄ－３）に示すごとく，接合媒体２１，２２を含めた上記２次加工体１０２に２次溝１２５を形成して，３次加工体１０３を得る。このとき，上記第１金型素材１１とその下面の接合媒体２２には，ハニカム状のスリット溝１５が形成されている（図１０（Ｄ－２））。

【００８３】次いで，第４工程において，図１１（Ｅ－１），（Ｅ－２），（Ｅ－３）に示すごとく，上記第１金型素材１１の下面に接合媒体２２を介して，上記有穴金型素材１３を接合する。この接合方法は，第２工程と同様である。これにより，４次加工体１０４を得る。

【００８４】次いで，第５工程において，図１１（Ｆ－１），（Ｆ－２），（Ｆ－３）に示すごとく，上記４次加工体１０４から第２金型素材１２及びその下面の接合媒体２１を除去する。以上により，ハニカム構造体成型用金型１が完成する。その他は，実施形態例４と同様である。

【００８５】この場合には，上記第１金型素材１１に形成されたスリット溝１５と，上記有穴金型素材１３の供給穴１３１との間に，上記接合媒体２２が残留することがない。そのため，この接合媒体２を，実施形態例４の場合のように選択的に除去する必要もない。それ故，一層容易にハニカム構造体成型用金型１を製造することができる。その他，実施形態例４と同様の作用効果を有する。

【００８６】実施形態例６

本例は，図１２～図１５に示すごとく，有穴金型素材１３の上面に予め接合媒体２２を接合しておく例である。図１２～図１５において，（ａ－１）～（Ｆ－１）は上面図，（ａ－２）～（Ｆ－２）は下面図，（ａ－３）～（Ｆ－３）は，（ａ－１）～（Ｆ－１）或いは（ａ－２）～（Ｆ－２）のＫ－Ｋ線矢視断面相当の説明図であ

る。

【００８７】本例のハニカム構造体成型用金型の製造方法につき，図１２～図１５を用いて説明する。まず，図１２に示すごとく，予め接合媒体２２を接合した上記有穴金型素材１３を作製しておく。

【００８８】即ち，図１２（ａ－１），（ａ－２），（ａ－３）に示すごとく，上記有穴金型素材１３における供給穴１３１形成前の状態である無穴金型素材１３０の上面に，接合媒体２２を接合する。次いで，図１２（ｂ－１），（ｂ－２），（ｂ－３）に示すごとく，上記無穴金型素材１３０と接合媒体２２に同時に供給穴１３１を形成する。これにより，供給穴１３１を除く上面に接合媒体２２を形成した，供給穴１３１を有する有穴金型素材１３を得る。

【００８９】また，予め接合媒体２２を接合した上記有穴金型素材１３を作製する方法としては，以下の方法もある。即ち，上記接合媒体２２は，上記有穴金型素材１３に予め形成された供給穴１３１と連通する位置に，ドリル加工，放電加工，プレス加工の少なくとも１手段によって連通穴を形成しておき，上記有穴金型素材１３の上面に接合する。もしくは，上記のごとく連通穴を形成した接合部材２２を，上記第１金型素材１１と上記有穴金型素材１３の接合前に両者の間に介在させておく。これにより，供給穴１３１を除く上面に接合媒体２２を形成した供給穴１３１を有する有穴金型素材１３を得る。

【００９０】本製造方法の第１工程においては，図１３（Ａ－１），（Ａ－２），（Ａ－３）に示すごとく，第１金型素材１１の上面に接合媒体２１を接合しておき，図１３（Ｂ－１），（Ｂ－２），（Ｂ－３）に示すごとく，１次溝１１５を形成する。このとき，該１次溝１１５は，上記金型素材１１と，その上面に接合された接合媒体２１とに同時に形成される。これにより，１次加工体１０１を得る。上記第１金型素材１１，第２金型素材１２，及び有穴金型素材１３の材質，更には，接合媒体２１，２２の材質及び厚みは，上記実施形態例４の場合と同様である。

【００９１】次いで，第２工程において，図１４（Ｃ－１），（Ｃ－２），（Ｃ－３）に示すごとく，上記第１金型素材１１の上面に，上記接合媒体２１を介して上記第２金型素材１２を接合する。このときの接合方法は，実施形態例４の場合と同様である。これにより，２次加工体１０２を得る。

【００９２】次いで，第３工程において，図１４（Ｄ－１），（Ｄ－２），（Ｄ－３）に示すごとく，接合媒体２１を含めた上記２次加工体１０２に２次溝１２５を形成して，３次加工体１０３を得る。このとき，上記第１金型素材１１と接合媒体２１には，ハニカム状のスリット溝１５が形成されている（図１４（Ｄ－２））。

【００９３】次いで，第４工程において，図１５（Ｅ－１），（Ｅ－２），（Ｅ－３）に示すごとく，上記第１金型素材１１の下面に，接合媒体２２を介して上記有穴金型素材１３を接合する。即ち，上述のごとく予め作製しておいた，接合媒体２２を上面に形成した有穴金型素材１３（図１２（ｂ－１），（ｂ－２），（ｂ－３））を，上記第１金型素材１１の下面に接合する。この接合方法は，第２工程と同様である。これにより，４次加工体１０４を得る。

【００９４】次いで，第５工程において，図１５（Ｆ－１），（Ｆ－２），（Ｆ－３）に示すごとく，上記４次加工体１０４から第２金型素材１２及びその下面の接合媒体２１を除去する。以上により，ハニカム構造体成型用金型１が完成する。その他は，実施形態例４と同様である。

【００９５】この場合にも，上記第１金型素材１１に形成されたスリット溝１５と，上記有穴金型素材１３の供給穴１３１との間に，上記接合媒体２２が残留することがない。そのため，この接合媒体２を，実施形態例４の場合のように選択的に除去する必要もない。それ故，一層容易にハニカム構造体成型用金型１を製造することができる。その他，実施形態例４と同様の作用効果を有する。

【図面の簡単な説明】

【図１】実施形態例１における，ハニカム構造体成形用金型の製造方法の説明図。

【図２】実施形態例１における，ハニカム構造体成形用金型の斜視図。

【図３】（Ａ）図１（Ｅ－２）のＡ－Ａ線矢視断面図，（Ｂ）（Ａ）のＢ－Ｂ線矢視断面図，（Ｃ）（Ａ）のＣ－Ｃ線矢視断面図，（Ｄ）図１（Ｄ－２）のＤ－Ｄ線矢視断面図。

【図４】実施形態例２における，（Ａ）ハニカム構造体成形用金型の平面図，（Ｂ）側面図，（Ｃ）スリット溝及び供給穴の説明図。

【図５】実施形態例３における，ハニカム構造体成形用金型の製造方法の説明図。

【図６】実施形態例４における，ハニカム構造体成形用金型の製造方法（１次工程～２次工程）の説明図。

【図７】実施形態例４における，ハニカム構造体成形用金型の製造方法（３次工程～４次工程）の説明図。

【図８】実施形態例４における，ハニカム構造体成形用金型の製造方法（５次工程）の説明図。

【図９】実施形態例５における，ハニカム構造体成形用金型の製造方法（１次工程）の説明図。

【図１０】実施形態例５における，ハニカム構造体成形用金型の製造方法（２次工程～３次工程）の説明図。

【図１１】実施形態例５における，ハニカム構造体成形用金型の製造方法（４次工程～５次工程）の説明図。

【図１２】実施形態例６における，有穴金型素材の作製方法の説明図。

【図１３】実施形態例６における，ハニカム構造体成形

19　　20

用金型の製造方法（１次工程）の説明図。

【図１４】実施形態例６における，ハニカム構造体成形用金型の製造方法（２次工程～３次工程）の説明図。

【図１５】実施形態例６における，ハニカム構造体成形用金型の製造方法（４次工程～５次工程）の説明図。

【図１６】従来例における，ハニカム構造体成形用金型の製造方法の説明図。

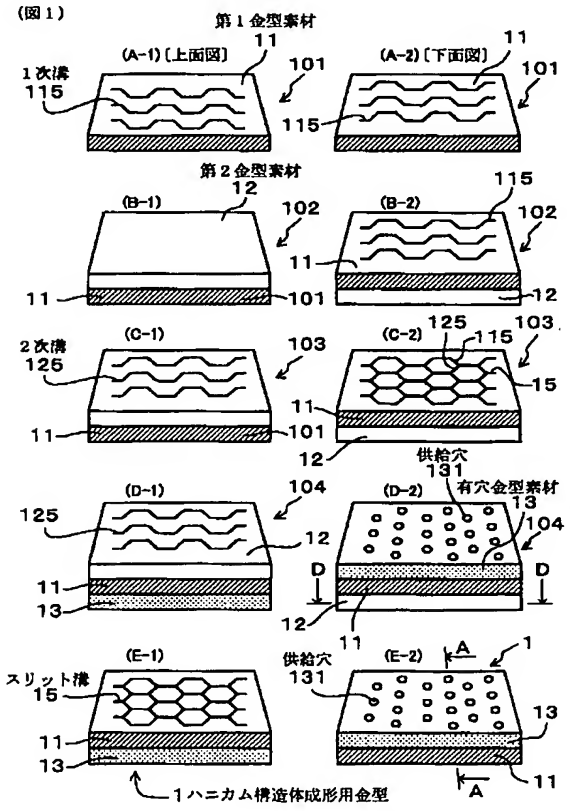
【図１７】（Ａ）図１６（Ｄ－１）のＥ－Ｅ線矢視断面図，（Ｂ）（Ａ）のＦ－Ｆ線矢視断面図，（Ｃ）（Ａ）のＧ－Ｇ線矢視断面図，（Ｄ）（Ａ）のＨ－Ｈ線矢視断面図。

【図１８】従来例のハニカム構造体成形用金型における，成形時の材料流れを説明するための（Ａ）スリット溝，及び（Ｂ）これに対応する２次溝の説明図。

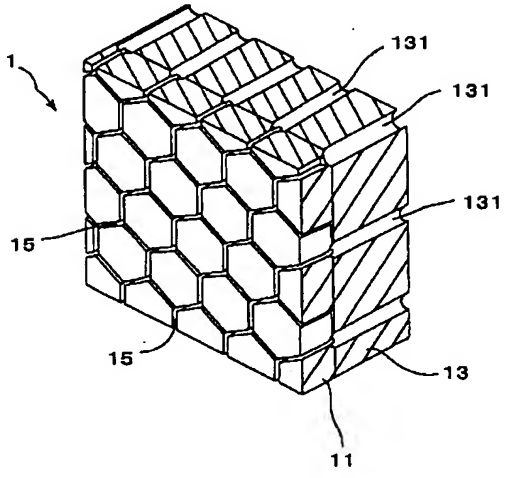
＊【符号の説明】

１．．．ハニカム構造体成形用金型，
１０１．．．１次加工体，
１０２．．．２次加工体，
１０３．．．３次加工体，
１０４．．．４次加工体，
１１．．．第１金型素材，
１１５．．．１次溝，
１２．．．第２金型素材，
１２５．．．２次溝，
１３．．．有穴金型素材，
１３１．．．供給穴，
１５．．．スリット溝，
２１，２２．．．接合媒体，

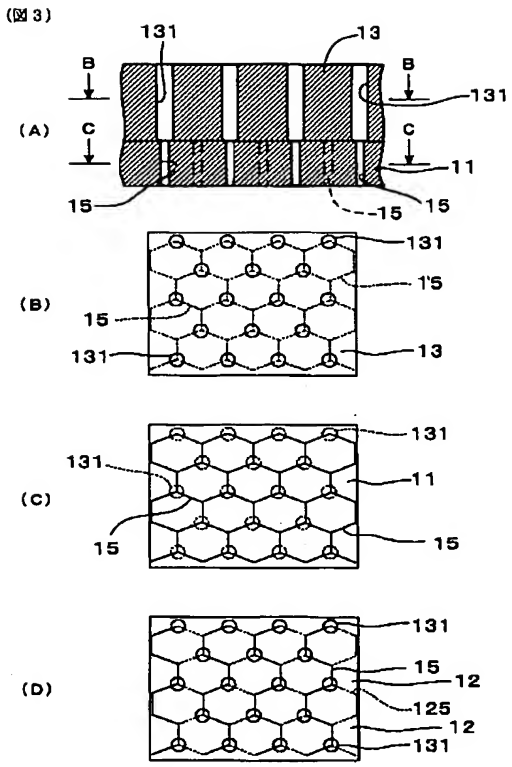
【図１】



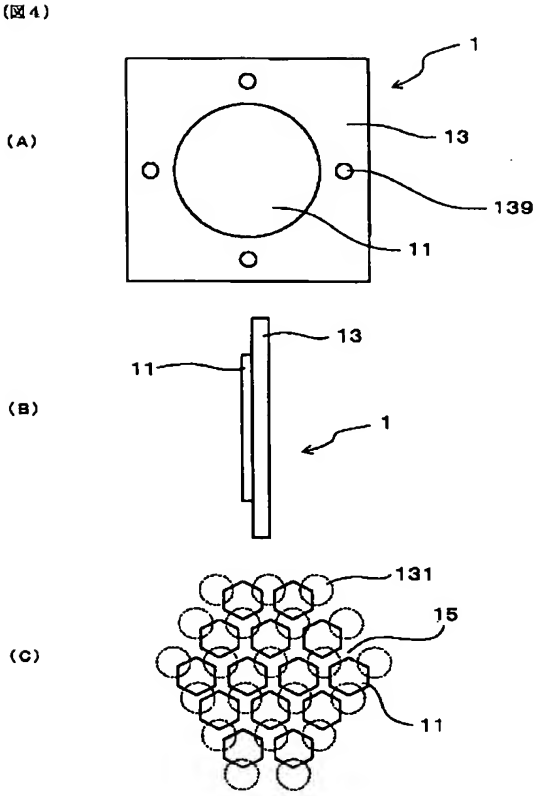
【図２】



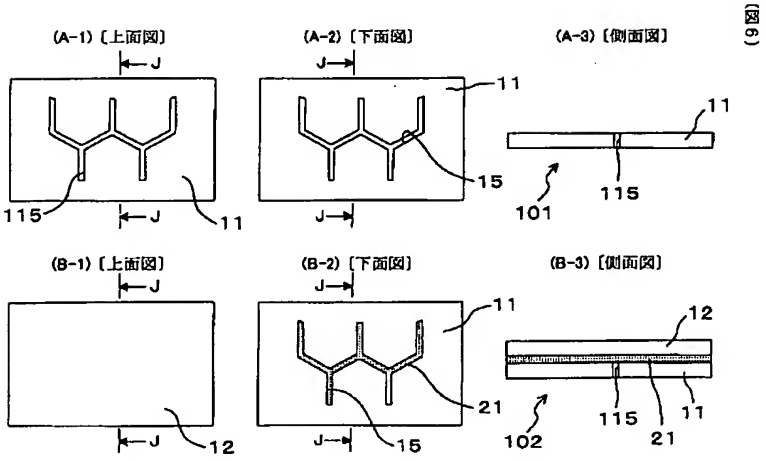
【図３】


(図３)
(A)
(B)
(C)
(D)
131
13
11
15
12
125
B
C

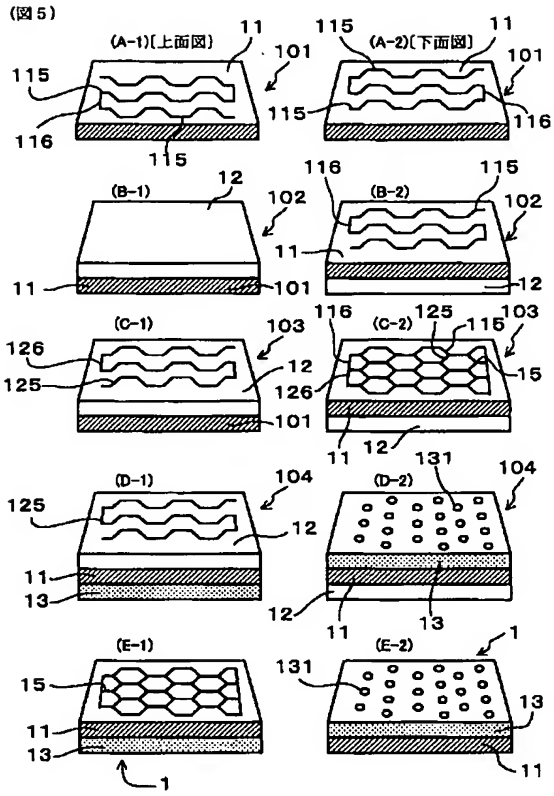
【図４】


(図４)
(A)
(B)
(C)
1
13
11
139
131
15

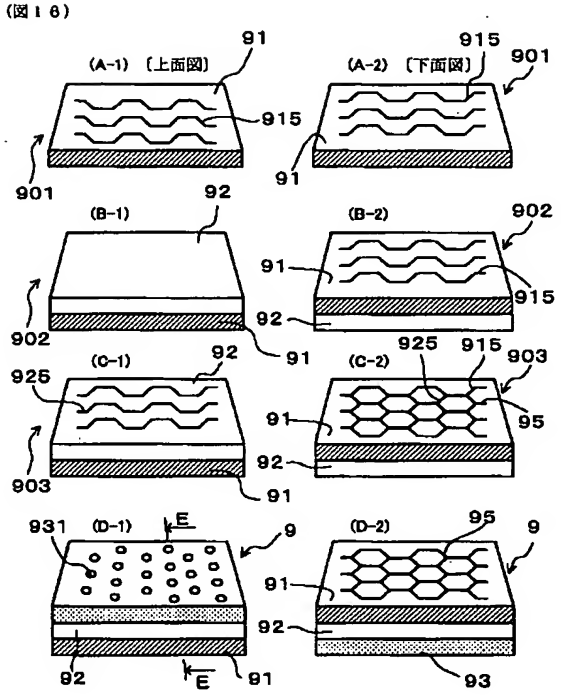
【図６】


(図６)
(A-1)〔上面図〕
(A-2)〔下面図〕
(A-3)〔側面図〕
(B-1)〔上面図〕
(B-2)〔下面図〕
(B-3)〔側面図〕
J
11
15
115
101
12
21
102

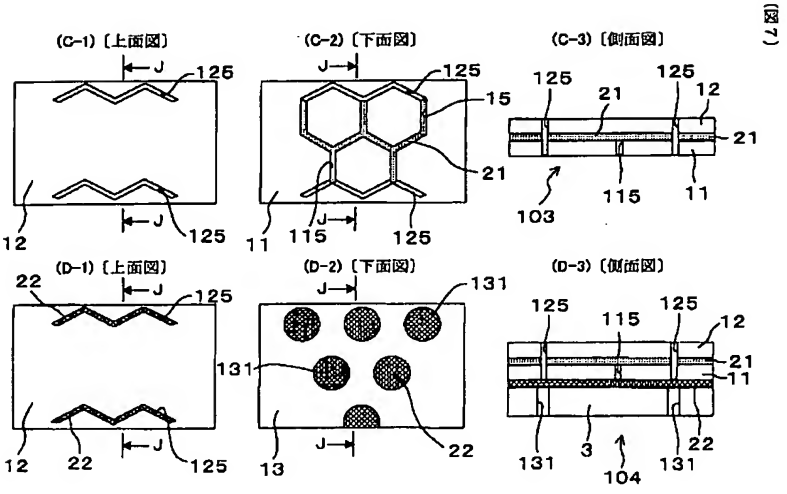
【図５】


(図５)
(A-1)〔上面図〕
(A-2)〔下面図〕
(B-1)
(B-2)
(C-1)
(C-2)
(D-1)
(D-2)
(E-1)
(E-2)

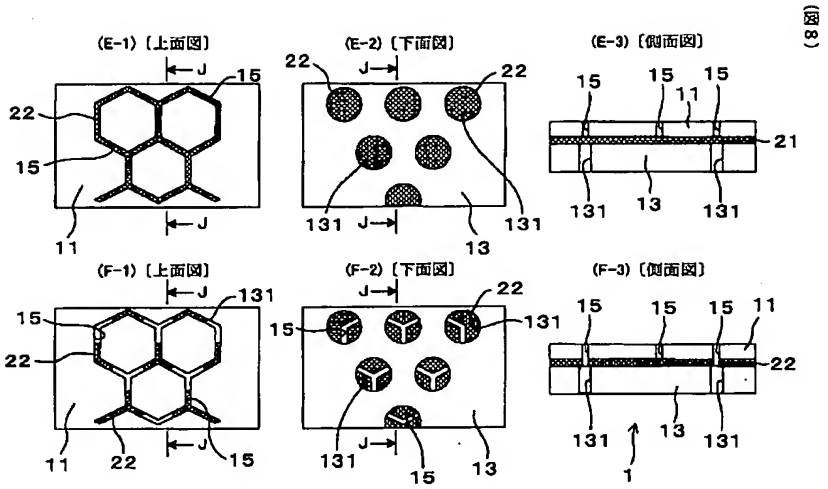
【図１６】


(図１６)
(A-1)〔上面図〕
(A-2)〔下面図〕
(B-1)
(B-2)
(C-1)
(C-2)
(D-1)
(D-2)

【図７】

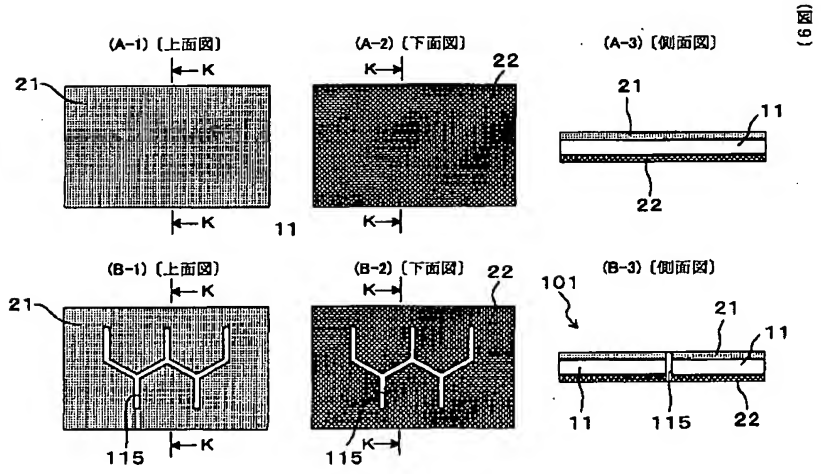

(図７)
(C-1)〔上面図〕
(C-2)〔下面図〕
(C-3)〔側面図〕
(D-1)〔上面図〕
(D-2)〔下面図〕
(D-3)〔側面図〕

【図８】


(E-1)〔上面図〕
(E-2)〔下面図〕
(E-3)〔側面図〕
(F-1)〔上面図〕
(F-2)〔下面図〕
(F-3)〔側面図〕
J
15
22
131
11
13
21
1

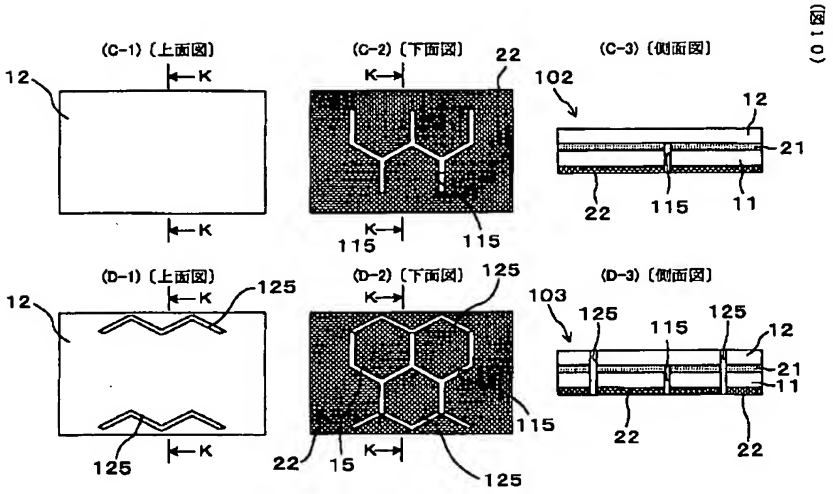
(図8)

【図９】


(A-1)〔上面図〕
(A-2)〔下面図〕
(A-3)〔側面図〕
(B-1)〔上面図〕
(B-2)〔下面図〕
(B-3)〔側面図〕
K
21
22
11
101
115

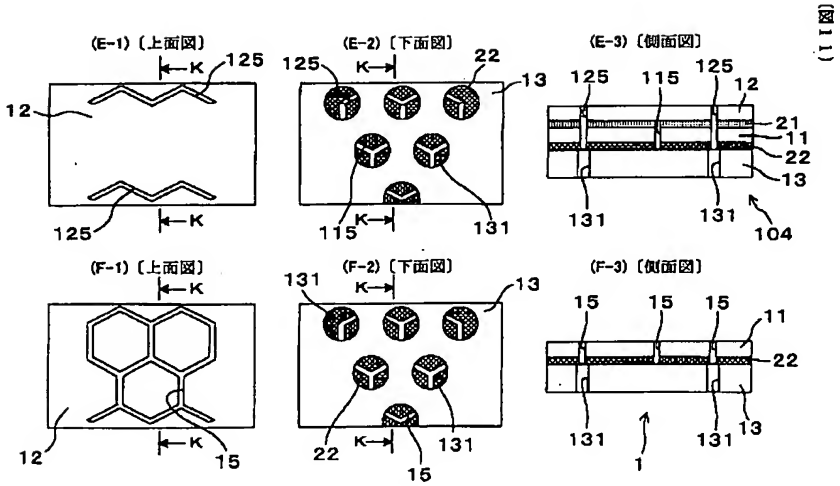
(図9)

【図１０】



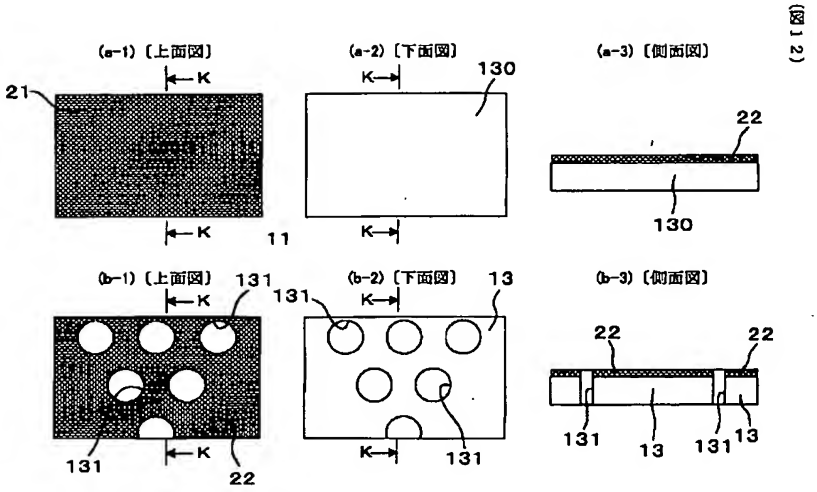
(図10)

【図１１】



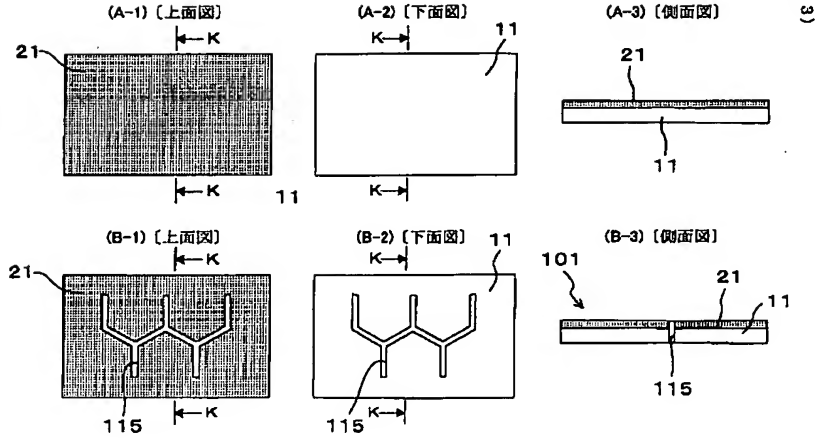
(図11)

【図１２】



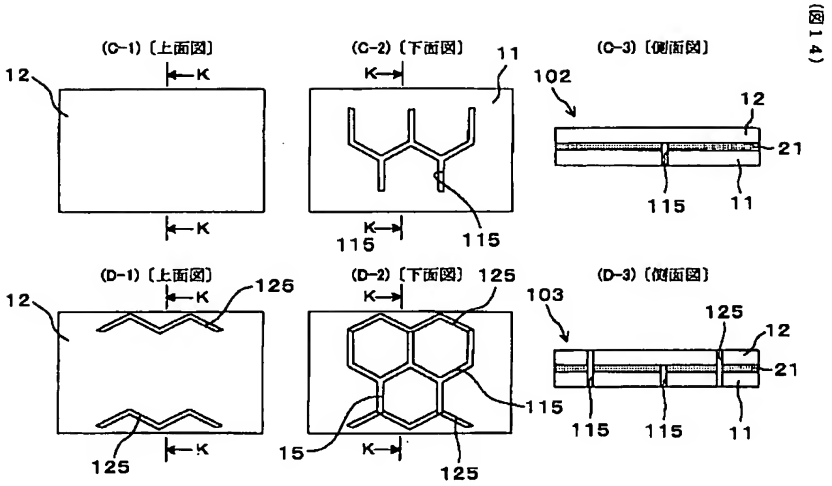
(図１２)

【図１３】

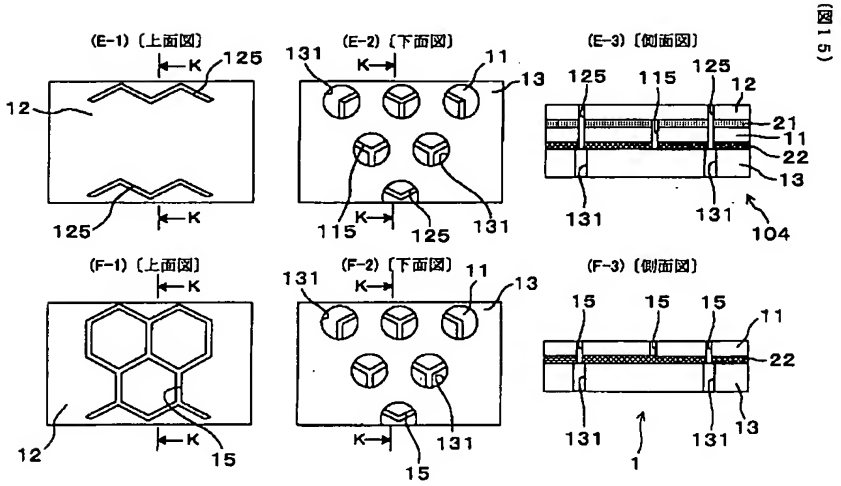


(図１３)

【図１４】

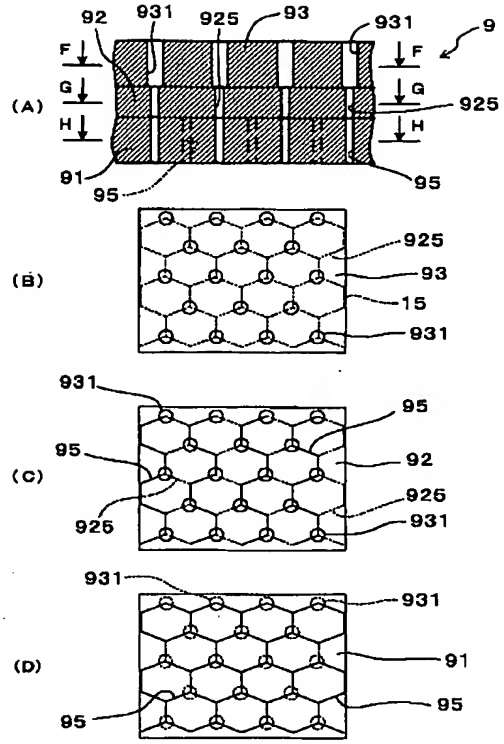

(C-1)〔上面図〕
(C-2)〔下面図〕
(C-3)〔側面図〕
(D-1)〔上面図〕
(D-2)〔下面図〕
(D-3)〔側面図〕
12
11
102
103
21
115
125
15
K
(図１４)

【図１５】


(E-1)〔上面図〕
(E-2)〔下面図〕
(E-3)〔側面図〕
(F-1)〔上面図〕
(F-2)〔下面図〕
(F-3)〔側面図〕
12
11
13
21
22
104
131
115
125
15
K
(図１５)

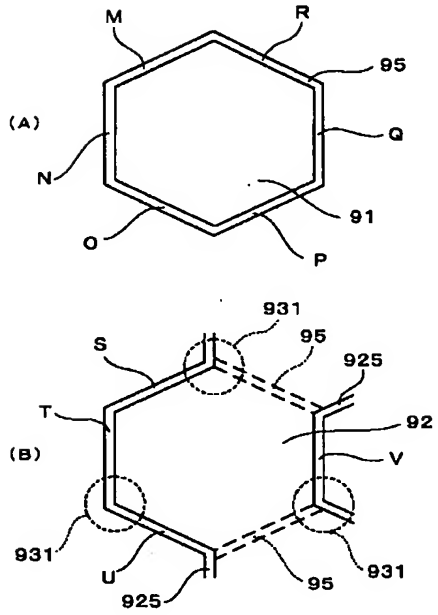
【図１７】

(図１７)



【図１８】

(図１８)



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Ｃ２２Ｃ　29/10		Ｃ２２Ｃ　29/10	

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